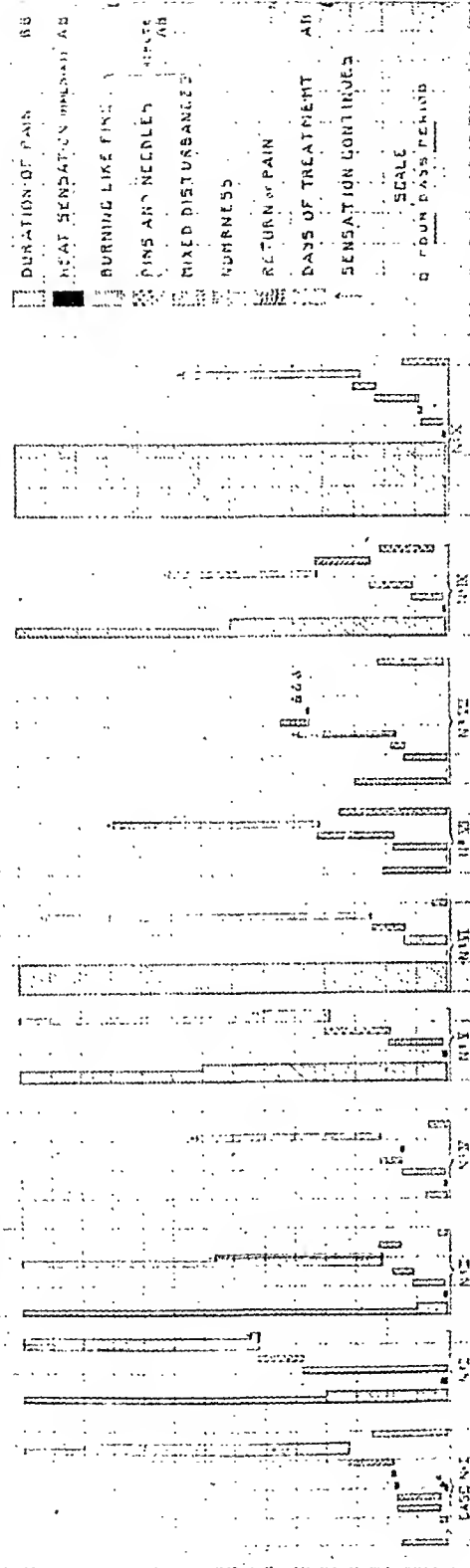Fig. 11. Synopsis of sensory changes after lumbar and sacral block. Comparatively large amounts of neocaine-alcohol were injected.

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CONTENTS OF NEW SERIES, VOLUME XI

ORIGINAL ARTICLES

MANAGEMENT OF BILIARY TRACT DISEASE*

Frank H. Lahey, m.d., f.a.c.s., and Sara M. Jordan, m.d., f.a.c.p.

BOSTON, MASS.

IT is now recognized that the management of biliary tract disease, like the management of almost all other intra-abdominal disease, has become a joint problem of surgeon and internist. While the treatment of gall-bladder infection and stones, and of cholangitis, is admittedly surgical, the diagnosis and the postoperative treatment of these conditions present problems of great interest to the internist.

Cholecystography, with its information concerning the function of the gall bladder, and also the estimations of bilirubin, have furnished valuable contributions toward the diagnosis of disease of the biliary tract which was once dependent upon symptomatology and obvious evidence of obstruction, such as icterus, acholic stools, bile in the urine, and the presence of abnormal contents in the bile obtained by medical drainage. These two contributions have not only added diagnostic criteria of great value to the equipment of the internist, but they have also played a part in the increase of his responsibility for the prevention of two undesirable conditions in the management of biliary tract disease.

These two undesirable conditions, which have occurred with considerable frequency in the past, are (1) surgery upon the gall bladder where it is not definitely needed; and (2) delay in surgery where gallstones or gall-bladder infection are present. Careful interpretation of all the diagnostic data now available should reduce the incidence of both these conditions to a minimum.

In our experience, unnecessary surgery for gall-bladder disease has resulted most frequently from failure to differentiate (1) malignant disease of the pancreas, and (2) functional disease of the colon: the former condition because of its symptoms due to obstruction of the biliary tract, and the latter for two reasons: (1) because the pain and distress which sometimes accompany functional disease of the colon simulates that of gall-bladder disease; and (2) because colonic irritability or instability is sometimes attended by a failure of the gall bladder to fill with the Graham test. The resulting positive test is used as evidence indicating the presence of gall-bladder disease, and makes surgery seem indicated. It has become our custom, therefore, in all cases where there is no obvious evidence of biliary tract obstruction or of actual stones, and where a barium enema and the history give evidence of colonic irritability, to use a positive Graham test only as preliminary evidence, to be confirmed or rejected by a later test, after the colonic irritability has been treated. In 44 per cent in a series of 65 such cases recently studied, the gall bladder filled normally after five to ten days of bowel management; whereas, with the same intravenous technique, it had previously shown an absence of filling or an inadequate filling. Chiray and Lomon* have recently described dystony and dyskinesia of the gall bladder as evidenced by its

* *Arch. d. mal. de l'app. digestif.*, 20: p. 5, 1930.

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* Read at the Thirty-third Annual Meeting of the American Gastro-Enterological Association, Atlantic City, N. J., May 5 and 6, 1930.

size and shape with cholecystography, and it is our opinion that the abnormality just described is due also to an abnormality of tone of the gall bladder associated with abnormal tone in the muscle of the colon. In the days before cholecystography, and even before it was found that the positive Graham test in the presence of an irritable colon, needs confirmation after the colon has been treated, cholecystectomy was done, and in our hands in a definite group of cases chronic cholecystitis diagnosed; but the symptoms were relieved only when treatment for the colon was also given.

The second undesirable condition which the internist has the greatest opportunity to prevent is delay in surgery, where gallstones or infection in the gall bladder or biliary ducts have been demonstrated; and the fact that mortality in gall-bladder disease is directly proportionate to the complicating factors involved in cholangitis, obstruction, and acute cholecystitis, together with the further fact that these conditions are so often the result of gallstones, make it desirable to remove gall bladders with stones as soon as they are discovered. Cholecystography has been of great value in the identification of both the cholesterol and bilirubin calcium stone. The so-called harmless or silent stones which have been brought to light by this method of diagnosis must be publicly denounced if we are to prevent the harmful sequelae of cholelithiasis.

In a follow-up report of our series of patients upon whom we have done biliary tract operations, Dr. R. B. Cattell of this Clinic has reported that the poorest results are in those patients operated with the diagnosis of chronic cholecystitis. This is a diagnosis which should be made with the same infrequency and with the same caution as is the diagnosis of chronic appendicitis. Both conditions exist, both are benefited by surgery when they do exist; but both are diagnosed and operations done for them much oftener when they do not exist than when they do.

To protect ourselves as much as possible against operative error in this condition, we have said that surgery shall be advised for chronic cholecystitis only under the following conditions: when the pain or discomfort is of sufficient magnitude to justify surgery; when all other conditions as a possible cause of the distress have been ruled out; when medical measures have failed to relieve the patient of the discomfort; and when cholecystogram shows at least suspicious evidence of gall-bladder pathology. With those criteria fulfilled, especially the one that discomfort be sufficiently great to justify surgery, cholecystectomy will then yield good results in this indefinite, intangible, and often wrongly diagnosed condition.

The following figures illustrate our position as to cholecystectomy as opposed to cholecystostomy. From 1910 to 1926, 65 cholecystostomies were done, in 635 operated cases, and out of these 65 cases, only 62 per cent were relieved over a period of a year or longer. From 1927 to 1929, only 8 cholecystostomies out of 413 biliary tract operations were done.

Acute cholecystitis has interested us very much in that, in the end-result studies of our operated cases, it has been definitely demonstrated to be one of the mortality-producing factors. As the result of our experience with these cases, we believe that it is desirable to delay surgery in acutely inflamed gall bladders as long as it is evident that the acute process is not progressing, in order to be able to do a deliberate and safe cholecystectomy upon a gall bladder not harboring an acute infection. If the acute process is quieting down, we continue to delay operation, if possible, until it is probable that most of the infection and induration of the gall bladder have subsided. If, however, the acute process does not progressively subside, and operation must be done in the presence of acute or subacute infection and induration, we feel strongly that in many cases the gall bladder should be drained until the acute process has sub-

sided, and cholecystectomy done at a second operation. We know from our own personal experience that it is here out of sentiment that one sometimes unwisely removes a gall bladder in one stage to save the patient a second operation, when preliminary drainage and later cholecystectomy would have lessened the chances of a fatality.

We have now operated upon 1110 patients having biliary tract disease. Up to 1926, the mortality was 5.4 per cent, and from 1926 to date the mortality is 2.2 per cent in 413 cases. We know that exclusive of hemorrhage, wound rupture, emboli and pneumonia, at least partly uncontrollable factors, a considerable part of the mortality of biliary tract surgery is the result of complications due to delay, and that the situation today in the surgery of biliary tract disease is very similar to that in which prostatic surgery was some years ago. Just as we know that the mortality of prostatic surgery is related largely to kidney function and the late effects of infection and obstruction on it, so we know in the same way that the mortality of biliary tract surgery is related to the liver and the late effects of infection and back pressure upon it.

It is in the patients who have been permitted to pass through repeated attacks of gallstone colic that we find the common duct stones, the pancreatitis and the cholangitis, the mortality-producing factors in the surgery of cholelithiasis and infection of the biliary tract. If we could limit our biliary tract surgery to those patients who have passed through but one or two attacks of biliary colic, or to those patients whose stones and infection were limited to the gall bladder, we believe that we could maintain an even lower mortality rate than we have had for the past few years.

We are strongly of the opinion that gall stones should be operated upon as soon as they are diagnosed and the general situation permits, just as with appendicitis. It is in our opinion wrong to permit patients to pass through repeated attacks

of biliary colic without firmly advocating surgery, and placing the responsibility for delay directly upon patients and their families. We are also of the opinion that there are no harmless gallstones, and that those gallstones found in the course of routine gastrointestinal examinations should be removed.

We have been very much interested in the incidence of common duct stones in our cases, and based upon our own experience we believe that a great many patients have common duct stones left in their ducts following cholecystectomy.

In the 634 patients having biliary tract disease upon whom we had operated up to 1926, the common duct was opened and explored in 96 or 15.1 per cent, and common duct stones were discovered in 52 or 8.2 per cent. In the 413 biliary tract cases of patients operated on since 1926, the common duct has been explored in 143 or 34.6 per cent of the cases, and stones have been discovered in 67 or 16.2 per cent of the cases.

By doubling the percentage of exploration of the common duct, we have doubled the percentage of discovery of common duct stones.

We know that common duct stones can and do exist as often if not oftener without jaundice or a history of jaundice, as they do with that typical evidence of their presence. We know that they are not infrequently present in the very lowest end of the common duct at the ampulla of Vater without marked dilatation or thickening of the common duct, and often without being definitely palpable because the lower end of the duct is surrounded by the head of the pancreas. We know furthermore from our own experience with these cases, that when a patient is operated upon for gallstones, and following the operation has a return of the same type of pain which he had before he was operated upon, that this pain is rarely due to adhesions or a plug of mucus in the duct, as is often stated, but is most likely to be due to a stone in the common and hepatic

duct which we have overlooked at the time of the cholecystectomy.

Based upon our own experience, then, we would strongly urge that a much higher percentage of patients should have their common and hepatic ducts opened and explored at the time that cholecystectomy is done, and that increasing the percentage of cases in which the common and hepatic ducts are opened and explored for stones and infection at the time of the cholecystectomy will, in experienced hands, lower and not elevate the immediate and remote mortality of biliary tract surgery.

Patients with painless jaundice present a problem which often severely taxes the combined diagnostic resources of the surgeon and gastroenterologist.

There is nothing more depressing in surgery than to have submitted to exploration the utterly hopeless and pitiable person for whom nothing, even in a palliative way, can be done. Yet many patients with carcinoma of the head of the pancreas and dilatation of the gall bladder can, by anastomosis of their gall bladder to their stomach, duodenum or jejunum, be given such comfort and prolongation of life over such a considerable period of time that the operation when applied in proper cases is well worth doing, and one which is justifiable even in the face of considerable risk.

Courvoisier's law has proved of real value to us in arriving at decision for or against operation, particularly in those patients with painless and progressive jaundice in whom the question of exploration or relief from jaundice comes up. Courvoisier's law is, in the presence of jaundice a dilated gall bladder is indicative that the biliary obstruction is due to cancer, while a contracted gall bladder is indicative that the obstruction is due to stone. Without going into the defects and modifications of the law, which we have discussed elsewhere in other articles on this subject, we believe that rarely will operation prove of any value in painless progressive jaundice with persistently

acholic stools, except when the gall bladder is dilated and palpable. When it is dilated and palpable, it is evident then (1) that the probably malignant obstruction is below the part where the cystic duct enters the common; and (2) the gall bladder wall is still normal enough to stretch and dilate, and so lends itself to anastomosis to the intestinal canal. When, therefore, the gall bladder is not dilated and palpable in painless and progressive jaundice in a patient with persistently acholic stools, exploratory operation will only shorten the days and increase the suffering of the patient, and burden the conscience of the surgeon who performs it.

In conclusion, it must be realized that the surgical treatment of gall bladder disease, cholecystectomy, and in many cases choledochostomy, may be all that is required to produce complete relief of symptoms. On the other hand, many of the symptoms of chronic cholecystitis, distension, gaseous eructations, and distress, are due apparently not to the dysfunction of the gall bladder primarily, but to an associated gastric or colonic malfunction. Achlorhydria and colonic irritability must often be treated in conjunction with cholecystectomy before relief of symptoms occurs. For this reason, as well as for completeness of diagnosis, the surgeon requires the aid of the gastroenterologist in the treatment of biliary tract disease, and in all cases a thorough gastrointestinal study should be made even though the first film shows gallstones and the symptoms are thought to be clearly due to this cause.

DISCUSSION

Dr. Lyon: This paper is a good example of what can be done by effective team-work between a capable surgeon and a skillful internist. As shown by Dr. Lahey, a reduction of operative mortality has been brought about by a more careful selection of patients for whom surgery is definitely required after a suitable period devoted to a more careful preoperative study of such patients; secondly, the mortality has been reduced by more

extensive preoperative preparation of the patient by the internist, a gentle surgical hand, and a conservative surgical attitude in not attempting to do more than the patient can withstand with especial care to reduce liver shock. After operation such patients are and should be returned to the internist for proper postoperative medical treatment. In addition to a suitable follow-up diet, and careful instructions to the patient as to how he must conduct his living for a full year thereafter, we can best accomplish a reduction in postoperative morbidity by duodenal tube drainage of the liver, extrahepatic ducts and pancreas. Such drainage, microscopy and bacteriology not only recognize the presence of states of cholangitis but, also, materially assist in improving the state of hepatitis which so frequently accompanies gall-bladder disease.

The second point I want to emphasize is to recall to your memory a paper which Dr. Swalm and I reported in 1927 on "Obstruction of the Cystic Duct of a Catarrhal Variety," a by no means uncommon condition. In such patients there is an inherent error of diagnosis by the Graham cholecystogram unless crosschecked by a duodenal drainage study, because in the cystic duct blocked with catarrh the dye does not enter or visualize the gall bladder. It is therefore, too frequently interpreted as a pathological gall bladder whereas in many cases the gall bladder is not actually diseased. The correct diagnosis can be established by the duodenal tube and microscope, as reported. Many such cholecystograms interpreted as gall-bladder disease can be restored by duodenal tube drainage to a state of normal cholecystographic function. Cystic duct catarrh is somewhat analogous to common duct catarrh or catarrh of the intrahepatic biliary tree, except for its location and for the fact that it does not necessarily, of itself, produce jaundice. Therefore, many such patients can be restored to health without surgery.

The third point I wish to stress is in con-nection with the greater frequency than is commonly recognized of the existence of multiple lesions in chronic intraabdominal disease. In very many patients with gall-bladder disease, on careful survey there will be found duodenitis or duodenal ulcer, an abnormal appendix (if not previously removed) and a a functional disturbance, if not organic disease of the intestines, most notably sigmoid colitis. I believe this happens so frequently that we should cease to speak in diagnostic terms of cholecystitis or duodenal ulcer as single entities and in our pre-survey always consider the case of cholecystitis plus what? or duodenal ulcer plus what? Failure to recognize this fact is the commonest cause for operation and re-operation.

Finally, I have found that many patients of advanced years with chronic calculous cholecystitis are essentially poor operative risks, and for these general medical management, with special reliance on duodenal tube management, is preferable to surgery, except in patients whose strength and morale are being worn down by repeated attacks of biliary colic. After ten years' experience with this group I can show a large number of patients, who although possessing gallstones and a functionless gall bladder, have been maintained in good health. Their condition is quite as good as if they had been successfully operated upon, and certainly better than those cases with bad myocardiums and depreciated kidney function plus injudicious surgical enthusiasm. Too many such patients are now six feet under the sod instead of possessing a reasonable degree of health.

DR. ALVAREZ: I think these papers prove, if we need any proof, that it is a wonderful thing for us to have someone outside of our group give us a "new slant" on our specialty. I agree with Dr. Lahey that it is better to have a patient cured of his ulcer but still needing a cholecystectomy than a patient cured of both ulcer and cholecystitis—but dead!

ORAL CHOLECYSTOGRAPHY

IN THE DIAGNOSIS OF CHRONIC GALL-BLADDER-DISEASE*

Robert C. Pendergrass, M.D.

AMERICUS, GA.

THE diseased gall bladder may underlie so many variable symptoms referable to the abdomen, the chest, the head, and even the extremities that it is often a difficult task to untangle the maze of conflicting symptoms and place guilt where guilt belongs. Our most reliable aids in this task are: (1) a carefully taken and thoughtfully considered history, (2) a complete physical examination, (3) clinical laboratory studies and (4) roentgenologic examinations of the gall bladder and intestinal tract. This paper will deal chiefly with the last named aid, roentgenologic examination.

SYMPTOMATOLOGY

While the ancient dictum of the probability of gall bladder disease in the patient who is "fair, fat, forty, full of flatus" and complaining of upper abdominal pain, is still a quite reliable guide, other symptoms should direct our suspicion to this organ. Among the more prominent of these are headache, constipation and chronic arthritis. Precordial pain simulating angina pectoris, even in radiation down the left arm, may occur. L. W. Grove[11] has operated upon several patients whose symptoms were almost classic of angina, but removal of a calculous gall bladder resulted in complete relief.

A study of the symptomatology in 30 operated cases in our series gave the following results:

Females 21 cases; males 9.

Average age: females 42; males 45.

Duration of symptoms: average six and one-half years; varied from six months to thirty years.

Pain: upper abdominal 17 cases; right lower quadrant 4 cases; right flank 2 cases; generalized abdominal pain 5 cases; and no pain complained of in 1 case.

Indigestion: 28 cases.

Sour stomach: 14 cases.

Gas: 27 cases.

Belching: 27 cases.

Nausea or vomiting or both: 19 cases.

Heart burn: 5 cases.

Palpitation: 4 cases.

Constipation: 25 cases.

Clay stools: 6 cases.

Tarry stools: 1 case.

Jaundice: 13 cases.

Headache: 11 cases.

Joint pains: 7 cases

Type of foods causing distress: all foods, 6 cases; greasy foods, 4 cases; sweets, 1 case; fruit juices, 1 case; and in 18 cases no particular type of food was mentioned.

It is easily seen that the complaints of indigestion, gas, belching and constipation predominated in this small series. Next in order of frequency were nausea, sour stomach, jaundice and headache. It is notable that 7 of the 30 patients complained of joint pains.

DIFFERENTIAL DIAGNOSIS

In their recent book[1] Graham, Cole, Copher and Moore list the following conditions which may be clinically confused with chronic cholecystitis: lesions of the stomach and duodenum; spastic constipation; intestinal allergy; carcinoma of the hepatic flexure; chronic appendicitis; cirrhosis of the liver; syphilis of the liver; lesions of the kidney; hemolytic icterus; spinal lesions, such as Pott's disease; chronic lesions of the right lung, such as pleurisy; slipping of the eleventh rib over the twelfth with resultant pain; and among the rarer causes, parasitic diseases of the gall bladder, such as echinococcus cysts and round worm infection.

LABORATORY DIAGNOSIS

The chief value of laboratory studies lies in differentiation of the obstructive and

a

b

hemolytic types of jaundice, by means of the Van Den Bergh reaction, red cell fragility tests, icterus index, examination of blood smears, determination of bilirubin content of the urine, etc. Leucocytosis is not a constant factor except in empyema of the gall bladder.

Analysis of the material obtained by magnesium sulphate drainage of the gall bladder is considered valuable by some, but my personal experience with this method as a diagnostic agent is so limited as to make any opinion expressed worthless.

ROENTGENOLOGIC EXAMINATION OF THE GALL BLADDER

Roentgenologic examination of the gall bladder should consist of (1) preliminary flat films, (2) cholecystography and (3) barium meal examination of the stomach and duodenum where indicated.

On the flat films we may demonstrate opaque calculi; occasionally, the outline of an enlarged gall bladder, such as a hydropic gall bladder; and in some instances renal stones, spinal lesions, enlarged liver, or pancreatic calcification. Any confusing shadows may be better identified later if

their presence is detected before employing cholecystography.

Cholecystography has been subjected

c

Fig. 1. Sthenic habitus. Normal gall bladder. (a) Twelve hours after taking dye orally. (b) Fourteen hours after dye. (c) Two hours after fatty meal. Note decrease in size of shadow and upward migration.

to the unfair demands of the unduly critical and the exaggerated claims of the enthusiastic. If we consider the rationale of the procedure, we may learn how much and how little we should expect from it.

To understand cholecystography, it is

necessary to review briefly the physiology of the gall bladder. From the mass of clinical, anatomical, and laboratory inves-

tigations, which have been ably reviewed by Graham,[2] Alvarez,[5] and others, the following facts seem definitely established: (1) Bile is excreted by the liver and fills the gall bladder largely by way of the cystic duct. (2) The gall bladder concentrates bile. (3) At periodic intervals, and apparently in response to digestive activity, the gall bladder empties its contents into the common duct and thence into the duodenum. The chief components of the emptying act seem to be (1) contraction of the gall bladder wall and (2) washing out of the gall bladder by the recurring flow of liver bile.[3]

The theory of a contrary innervation of the sphincter of Odi and the gall bladder is as yet in the throes of dispute among the physiologists. Alvarez[6] states that there seems to be a connection but doubts the theory of contrary innervation, and thinks that the causes are chiefly chemical, as shown by the work of Boyden concerning the effect of egg yolk and fat on emptying of the gall bladder.

Cholecystography, or the Graham test, is primarily a test of gall bladder function, and is based on the physiologic factors.

It consists in introducing into the circulation, either intravenously or via the intestinal tract, a halogenated pthalein

FIG. 2. Hypersthenic habitus. Normal dye concentration but delayed emptying. (a) Fourteen hours after dye. Film made in expiration. (b) Fourteen hours after dye. Film made in inspiration. Note gall bladder shadow projected below rib. (c) Four hours after fatty meal. Slight decrease in density but no decrease in size of shadow.

containing iodine. Carried by the circulation to the liver, the dye is excreted in the bile and then obeys to some extent the physiological laws governing the con-

centration and expulsion of bile by the gall bladder. It is thus obvious that the following requisites are necessary for

(2) The liver must be able to excrete the dye into the bile.

(3) The cystic duct must be open.
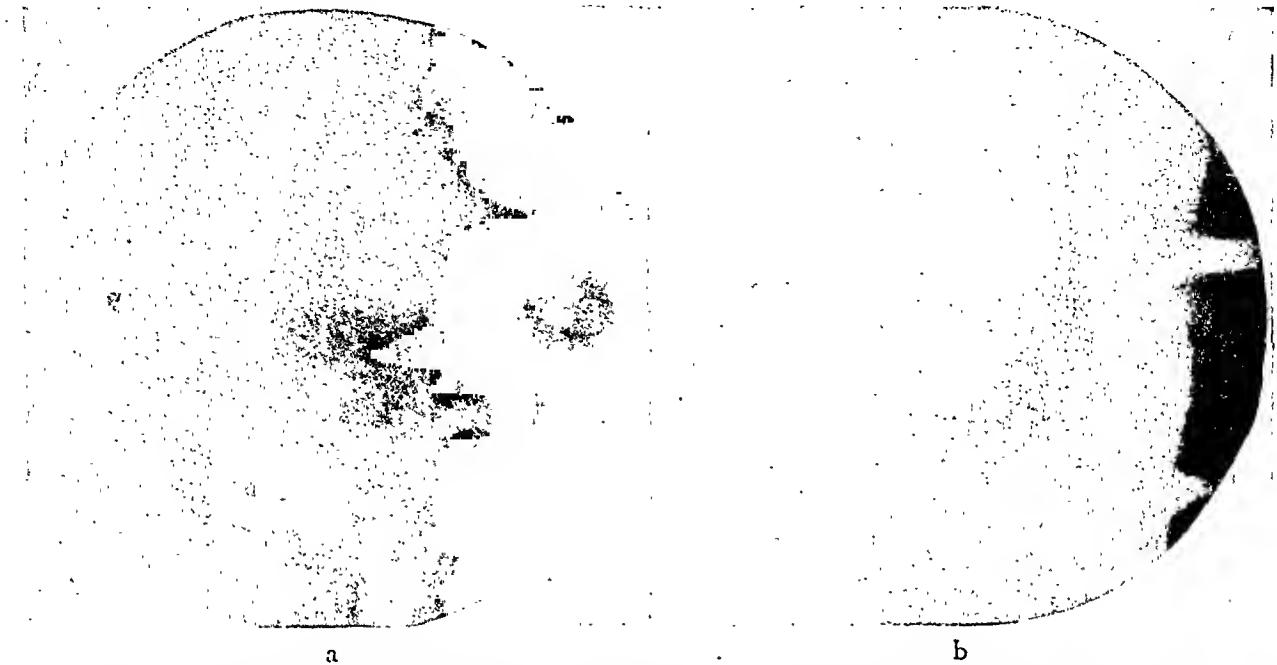
FIG. 3. Asthenic habitus. Normal gall bladder. (a) Thirteen hours after dye. Note gall bladder shadow overlying transverse processes of spine. (b) Same. Lateral view used to project gall bladder clear of transverse processes.

obtaining a shadow of the gall bladder by cholecystography:

(4) The gall bladder must be able to concentrate the dye to some degree.

FIG. 4. Asthenic habitus. Use of vertical oblique position to project gall bladder shadow away from spine. (a) Posteroanterior view, prone position. Note gall bladder shadow (retouched) overlying spine. (b) Vertical oblique view (Bucky technic) showing gall bladder clear of spine.

(1) Sufficient dye must enter the circulation.

In interpreting cholecystograms we therefore note (1) the time required for

appearance of dye in the gall bladder; (2) the degree of dye concentration as noted by the density of the gall bladder

by reason of their contrast with the more dense dye shadow.

In the oral method of cholecystography,
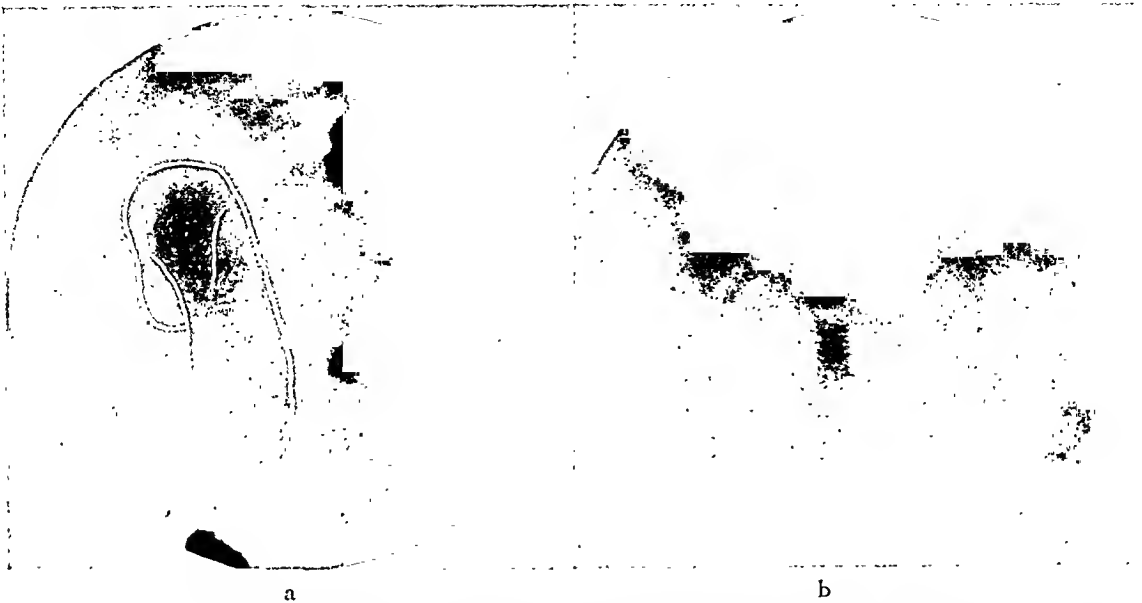
FIG. 5. Two cases of extrinsic deformity of gall bladder. (a) Angulation at neck of gall bladder (retouched). (b) Similar angulation, and also an incisura in mid-portion of the organ.

shadow; (3) the time required for the gall bladder to empty the dye-stained bile in

as used in the cases herein summarized, a gall bladder shadow of good intensity
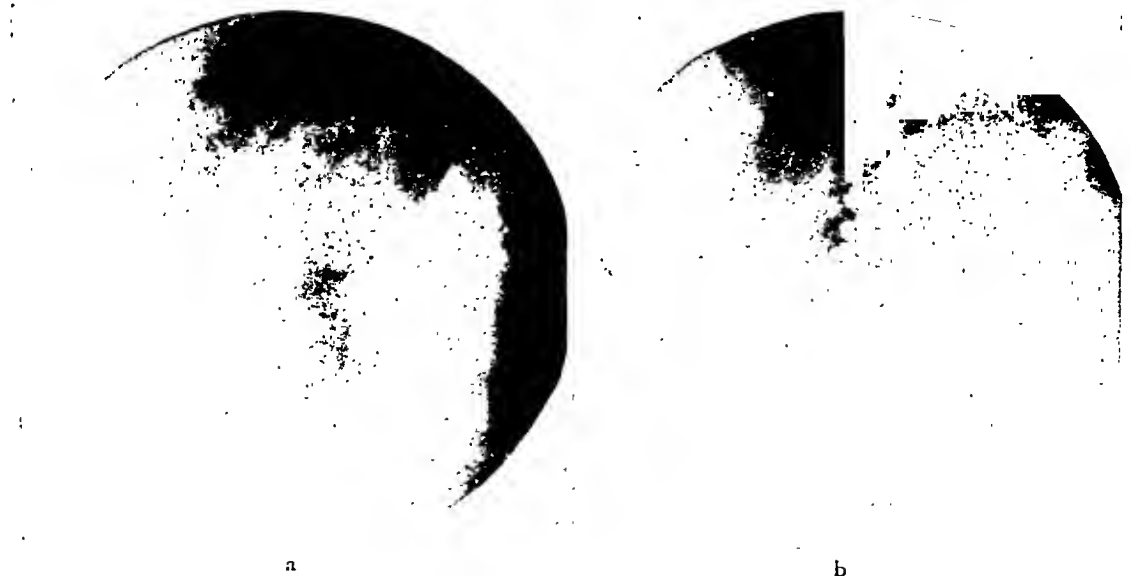
FIG. 6. Multiple cholesterol stones, 26 stones found at operation. (a) Fourteen hours after dye. Note multiple negative shadows. (b) Two hours after fatty meal. Note contracted gall bladder with negative shadows remaining within its outline. This excludes gas as cause of shadows.

response to a fatty meal and (4) whether or not cholesterol stones are demonstrated

should be obtained in from twelve to sixteen hours after administration of the dye,

and the organ should be at least one-half empty two hours after a meal of egg yolk, butter and cream has been eaten.

TECHNIC OF ORAL CHOLECYSTOGRAPHY

The technic used in our laboratory is as follows:
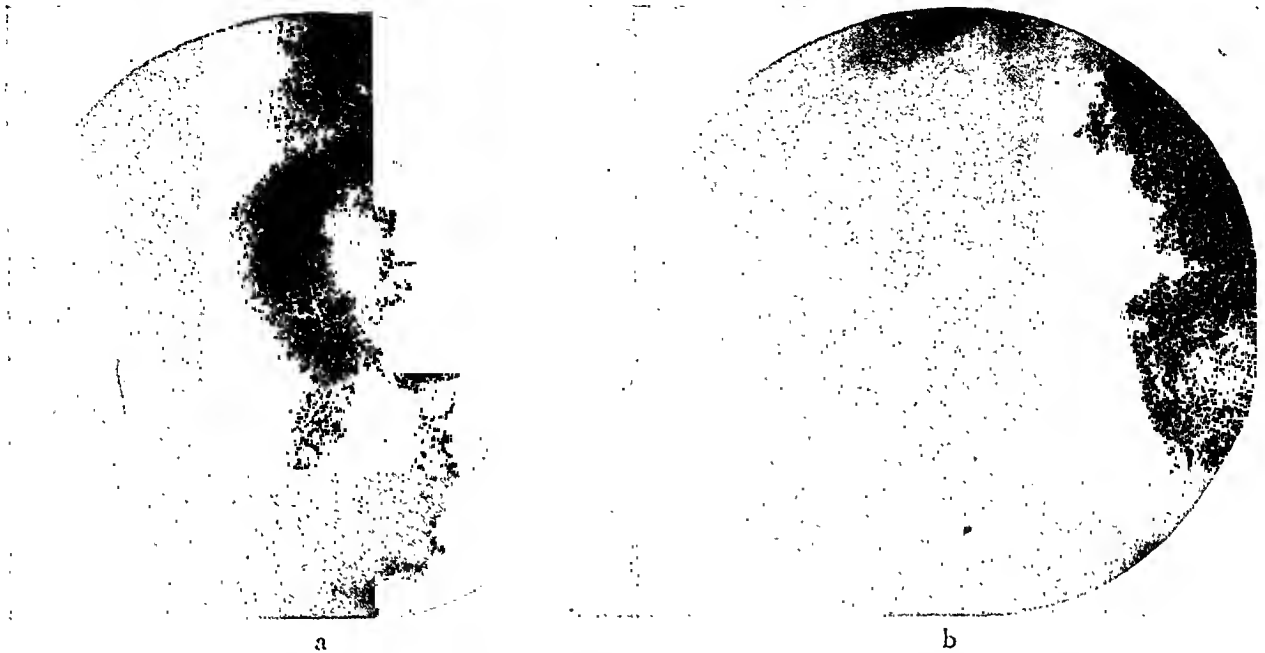
FIG. 7. Single negative density defect. One cholesterol stone and "strawberry" mucosa found at operation. (a) Fourteen hours after dye. (b) Two hours after fatty meal. Note ring of dye surrounding stone shadow. Excellent function despite presence of stone and diseased mucosa.

As we are reminded by Alvarez, a diseased gall bladder may show a fairly good concentration of the dye, and it is also known that a diseased gall bladder will empty its contents fairly readily in many cases. In other words, the degree of concentration of the dye is not in direct proportion to the amount of pathology existing in the gall bladder. We know that a gall bladder which contains stones is diseased, else stones would not be present; yet such gall bladders will often empty well in response to a fatty meal. Illingworth[10] in a recent article discussing cholesterosis of the gall bladder, states: "Cholecystography indicates that in uncomplicated cases the concentration of bile and the emptying in response to fats are not affected."

In many cases the major pathology is found in the outer coats of the gall bladder and not in the mucosa, and this may explain to some extent the discrepancy in concentration of the dye by a diseased viscus.

1. The patient is given a cathartic, preferably castor oil, on the night before the dye is taken, and an enema the following morning.

2. The afternoon after the cathartic, preliminary flat films are taken.

3. Supper that same evening at 7 P. M. consists of dry toast, baked Irish potato or cream of wheat, or oatmeal, and either tea, coffee or water. No milk is allowed.

4. One hour later (8 P. M.), Keraphen, a powdered preparation of tetraiodophenolphthalein, is given in a half glass of cold water, followed by a half glass of cold water. After that, no food or drink is allowed until after the first film of the series is made at 9 A. M. the following day. In our later cases, we have allowed fruit juices, weak tea, and coffee without cream after taking the dye, as they seem to have no effect on emptying of the gall bladder, and the fruit juices apparently allay nausea in some patients.

5. Films are obtained at thirteen and fifteen hours after taking the dye. Then

the patient is given a meal of two soft boiled eggs with butter, buttered toast, one glass of sweet milk and one glass of

ROENTGENOGRAPHIC TECHNIC

The preliminary flat films are usually made on a 10 × 12 film using fast exposure,

a   b

FIG. 8. Hypersthenic habitus. Single negative density filling defect simulating stone (retouched). Compare with Fig. 7. (a) Showing single, rounded negative density shadow. 14 hrs. (b) Oblique view, showing rounded shadow partly projected from gall bladder shadow. Defect due to gas.

pure cream. Two hours later a film is made, and if the gall bladder is not at least one-half empty a second film is made at four hours after the fatty meal.

The following additional points have been helpful in employing this technic:

1. In nervous patients who are subject to nausea at the least provocation, barbital grain v or luminal grain jss is given two hours before taking the dye.

2. Where a tendency to diarrhea is known to exist, paregoric dr. 1 to 2 is given one hour before the evening meal, on the same day the dye is taken. This slows intestinal peristalsis and apparently allows a better absorption of the dye. Fitzgibbon[8] has recently advocated this practice. We have employed paregoric with good results in patients who have been subjected to operations such as gastro-enterostomy or pyloroplasty, in whom small intestinal peristalsis is usually increased.

3. When such a meal is not readily available, an egg malted milk made with pure cream produces quite a satisfactory emptying of the gall bladder.

as for a stomach, on one film; and on another we employ Bucky technic, with a medium sized cone centered over the gall bladder region.

The cholecystograms are made with Potter-Bucky technic, a comparatively low voltage, 25 ma. double screens, cone. Two exposures are usually made, to produce varying densities. If the gall bladder is unusually high, one film is made in inspiration; otherwise expiration is the method of choice. If the transverse processes of the spine overlap the gall bladder shadow, an oblique or lateral view is taken. Where spine pressure affects the dye shadow, sand bags are used to support the patient from the table, or films are made in the erect position.

The films should show: good density of the spine and ribs; the outline of the liver edge; the outline of the right kidney and a clear outline of the gall bladder. Over-exposure is the most common fault. Any respiratory movements make the films worthless, especially in detecting small stone shadows.

When stone shadows are seen, or even suspected, a film should be made after the emptying meal, since the stones may often after ingestion, and emptying of at least one-half the dye in two hours after taking the fatty meal described in the technic.

a

b

c

Fig. 9. Use of cholecystography to confirm diagnosis of opaque gallstone, shadow of which noted on upper edge of uterosalpingograph. (a) Rounded opaque shadow noted on flat film. (b) Fourteen hours. Posteroanterior view. (c) Fourteen hours. Lateral view. Note ring shadow remaining within limits of dye shadow.
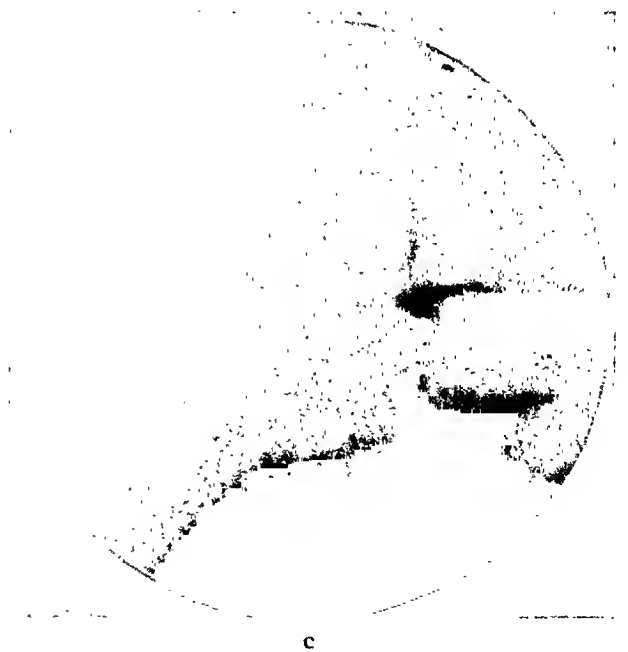
be better detected when they are more closely packed together in the contracted viscus. The persistence of identical negative density shadows in the filled and partly emptied gall bladder definitely confirms the nature of such shadows.

Where gas shadows simulate stones, several examinations in various positions may prove the true nature of the shadows in question.

ANALYSIS OF 216 ROENTGENOLOGIC EXAMINATIONS

A study of 216 consecutive examinations of the gall bladder made in our clinic is here presented. Of this number, 14 patients had only flat film examinations without cholecystography. The remaining 202 had either cholecystography alone or a preliminary flat film examination followed by cholecystography. The 202 cholecystograms represent 202 cases; in many of these the examination was repeated at least once, so that the actual number of roentgenologic examinations was somewhat larger.

The cholecystographic findings were classified as follows:

1. *Normal.* In this group are those patients showing a normal concentration of the dye in from twelve to sixteen hours

2. *Pathological.* These were divided as follows:

a. Absent shadow.

b. Faint shadow.

c. Mottled shadows suggestive of calculi.

d. Delayed emptying.

e. Definite calculi shadows.

3. *Repetition of Examination Requested but Not Obtained.* Cause of such request.

subjected to a repetition of the study where the first examination was unsatisfactory. We regard repetition of the test
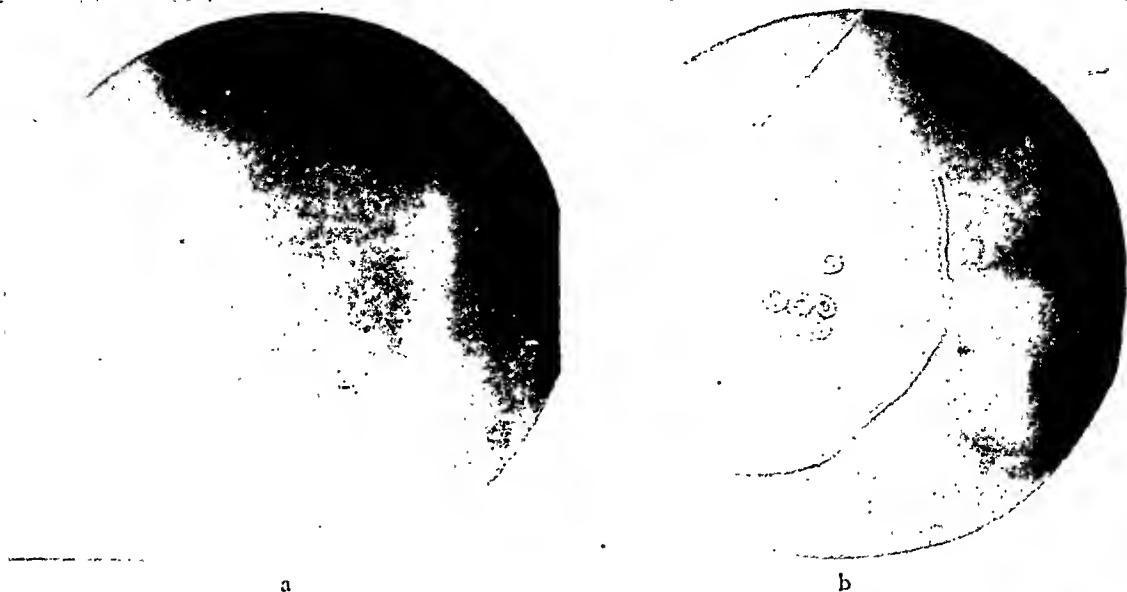
FIG. 10. Two cases of hydropic gall bladder containing calculi, confirmed at operation. (a) Fourteen hours. Note large shadow with faint dye concentration. Negative shadows can be made out in lower portion of gall bladder. 36 stones found at operation. (b) Hydropic gall bladder. 16 hrs. 6 cholesterol stones found at operation; purulent material in gall bladder. Dye concentration faint on original film; retouched.

a. Absent shadow.

b. Faint shadow.

c. Confusing gas shadows.

The results of the examinations, grouped here, were as follows:

1. *Normal*, 78 cases or 38 per cent.

2. *Pathological*, 113 cases or 51 per cent, divided as follows:

a. Absent shadow, 23 cases or 20 per cent.

b. Faint shadow, 43 cases or 38 per cent.

c. Mottled shadows suggestive of calculi, 12 cases or 10 per cent.

d. Delayed emptying, 18 cases or 16 per cent.

e. Definite calculi shadows, 17 cases or 15 per cent.

3. *Repetition of Examination Requested but Not Obtained.* Eleven cases divided as follows:

a. Absent shadow, 7 cases.

b. Faint shadow, 3 cases.

c. Gas defects, 1 case.

All cases classified as pathological were

as one of the most important features of a carefully made oral examination.

It is noted that cases showing no shadow and those showing definite calculi shadows constitute about one-third of the total pathological cases. The other two-thirds, in which a diagnosis of pathological gall bladder was based on the less definite findings of faint shadow, mottled shadow and delayed emptying, offer the chief diagnostic problem, and to my mind the richest field for future developments in cholecystography. Oakman[9] recently called attention to the diagnostic value of the faint shadow in oral cholecystography. It is in these cases that the personal equation of the evaluation of a normal shadow enters. They offer more diagnostic pitfalls than any other group of cases, and deserve the careful consideration of everyone interpreting cholecystograms. Technically good films are a necessity here, since under or over exposure may render it difficult to judge the actual concentration

of the dye. Moore, Graham, et al.[4] state that retention of the dye beyond a two or three hour period after a fatty meal is of no pathological significance if concentration is normal prior to the meal, and offer as explanation either reabsorption of dye from the intestinal tract or prolongation of the starvation period. In case of a faint shadow coupled with delayed emptying, the diagnosis of a ·pathological gall bladder may be safely made. This certainly is true of the hydropic gall bladder, and 2 such cases are included in this series and were confirmed at operation.

Of the 200 patients examined 30, or 14 per cent, have to our knowledge come to operation. These cases have been reviewed as follows, comparing the roentgenologic diagnosis and the operative diagnosis:

Of the 26 cholecystographies in which a diagnosis of "pathological gall bladder" alone was made thirteen times all 13 showed a chronic cholecystitis and 4 also showed stones, an agreement of 100 per cent in the preoperative and postoperative diagnosis.

Of 6 cases in which stones were diagnosed, 6 showed stones at operation, an agreement of 100 per cent.

Of 4 cases diagnosed as normal, 2 were normal and 2 showed calculi, an agreement of 50 per cent. A review of these films indicates that the degree of dye concentration was below normal and the diagnosis of a normal gall bladder was not warranted in the face of the faint shadow.

In 3 cases in which a repetition of the test was asked but not obtained, 2 were normal and 1 showed a chronic cholecystitis at operation.

Of 3 flat film studies which showed no pathology but in which use of the dye method was requested, 1 case was normal and 2 were pathological, of which 1 had a gumma of the liver in addition to a diseased gall bladder.

In 1 flat film study showing stones, diagnosis was confirmed at operation.

COMMENT

The writer wishes to emphasize that cholecystography represents only one witness for the prosecution in the case against the diseased gall bladder. It is not infallible. The roentgenologic findings should be carefully correlated with the history, physical findings and laboratory reports, and in borderline cases, if the clinical indications of a diseased gall bladder are stronger than the roentgenologic evidence, then the clinical findings should form the basis of the diagnostic decision.

It is also to be remembered that a recent mild attack of cholecystitis may leave the gall bladder so little impaired that dye concentration is normal. Failure to recognize this fact may lead to error in the retrospective diagnosis of recent attacks of upper abdominal pain.

If cholecystography is employed with a full recognition of its possibilities and its limitations; with proper regard for details of technic; with judgment in interpretation; and with broad clinical approach to the case in question, then and only then, is it a reliable aid in the diagnosis of chronic gall bladder disease.

SUMMARY

1. The diagnosis of chronic gall bladder disease is discussed with reference to the symptomatology, differential diagnosis, laboratory diagnosis, and roentgenologic diagnosis.

2. Thirty operated cases are analyzed according to symptomatology.

3. The rationale, technic, and interpretation of cholecystograms are discussed.

4. The findings in 216 consecutive examinations of the gall bladder are tabulated.

5. Comparison of the roentgenologic and operative diagnosis in 30 operated cases is presented.

6. Comment is made upon the relative position of cholecystography in the diagnostic scheme in chronic gall bladder disease.

INTRINSIC CARCINOMA OF THE LARYNX*

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WITH the exception of surface carcinoma, there is no location in the body where the results of surgery are more satisfactory than in laryngectomy for intrinsic carcinoma of the larynx. However, the majority of cases of carcinoma of the larynx are in so advanced a condition when first seen by the laryngeal surgeon, that it would seem either the diagnosis is extremely difficult and the condition poorly understood, or that there is an unwarranted prejudice against the operation.

Let us consider the differential diagnosis of carcinoma of the larynx.

There are no other carcinomatous lesions that indicate their presence so early and so definitely as carcinoma of the larynx. We know that 90 per cent of carcinoma of the larynx have as the initial symptom a persistent hoarseness, with pain, dryness and dysphagia developing as later symptoms. Yet it has been shown that there is an average lapse of eleven and a half months between the onset of hoarseness and the time a definite diagnosis is made. The blame for this cannot be wholly ascribed to the profession. The patient, not having been taught the seriousness of the symptom, usually treats his condition with home remedies and, because there is little discomfort associated with the hoarseness, delays seeing a physician.

Considering hoarseness as the early and predominant symptom, let us see what the other conditions are that produce hoarseness, and present some of their differential points.

1. *Simple Chronic Infections*, secondary to chronic tonsillitis, sinusitis, infected teeth, inordinate use of tobacco and alcohol, hysteria and excessive use of voice. This hoarseness is usually transient and readily clears up when the causative agent is corrected.

2. *Specific Chronic Infections.* Leprosy and rhinoscleroma at times occur, but by far the most common and perplexing lesions to differentiate from carcinoma of the larynx are syphilis and tuberculosis of the larynx.

(a) Syphilis, almost invariably, is a diffuse lesion of the larynx, which develops rapidly and ulcerates early, has little or no associated pain and is usually demonstrated by a positive Wassermann reaction.

If found in conjunction with cancer, a positive Wassermann reaction is one of the stumbling blocks in the retardation of the diagnosis. With antiluetic therapy the slow and temporary improvement in the laryngeal carcinoma is, for a period, misleading, because after a few months the lesion rapidly takes on a more definitely carcinomatous nature and valuable time has been lost. In true laryngeal syphilis, besides typical characteristic lesion, the growth recedes with such unmistakable rapidity under antiluetic therapy that any question of doubt as to the causative agent is removed.

(b) Tuberculosis of the larynx is nearly always secondary to tuberculosis of the lungs. It has its origin in the inter-arytenoid space and is usually symmetrically bilateral and most marked on the posterior portion of the pharynx, associated with a pale edematous area around it. Ulceration is rather early and quite painful, and with it, dysphagia.

By x-ray examination of the lungs and examination of sputa, and by its response to ultraviolet light therapy the tuberculous lesion is easily distinguished.

3. *Benign Neoplasms.* Papillomas, angiomas, fibromas, all generally occur early in life. Singers' node is a benign occupational hypertrophy which clears up readily with rest.

4. *Prolapse* of the ventricle of the larynx is usually transient.

5. *Postoperative Laryngeal Paralysis* is more often associated with thyroid operations, and usually improves in three to six months.

6. *Sarcoma of Larynx*, occurring in youth, accounts for only 2 per cent of the laryngeal newgrowths and carries a poor prognosis.

7. *Carcinoma of Larynx* occurs most often after the thirtieth year in men, and constitutes 98 per cent of the malignant neoplasms of the larynx; 96 per cent of these are squamous cell in type and are of Group 4 malignancies.

Thus we see from these conditions that cause hoarseness, none is without a serious outlook if not properly treated in its incipiency, and we can assert that hoarseness per se warrants early attention and correction.

Any person over thirty years of age who is subject to voice changes or persistent hoarseness should be told the possible seriousness of such a symptom and be given a thorough indirect laryngeal examination by a competent man as soon as possible. If any question of a doubt in the diagnosis arises, direct laryngoscopy should be resorted to. Unless the condition clears up, repeated examinations should be made, at least once a month, until the hoarseness has disappeared, or a definite diagnosis ascertained.

A misleading impression has crept into the literature that immobility of the cord is an early diagnostic sign pathognomonic of carcinoma of the larynx.

We know that any interference with the movement of the vocal cord is dependent upon the location, extent and type of the lesion present. In the case of cancer, the immobility is caused by the neoplasm penetrating into the subadjacent muscles, and the more superficial the growth, the less probable is the infiltration into the muscles. It follows that the diagnosis should be made before the cord becomes immobile, for, as an early sign we find that the cord is immovable or impaired in its motion in about 56 per cent of the cases,

but in 44 per cent of the early cases there is no disturbance in the mobility of the cord; so this, as an early diagnostic sign, is not reliable, and is of little importance in differentiation between carcinoma and syphilis or tuberculosis.

It is very important that the diagnosis be made before the cord becomes immobile. For immobility is usually dependent upon infiltration posteriorly into the base of the arytenoids, together with the extension of the growth in three possible directions.

1. Across the anterior commissure,

2. Posteriorly to the ventricular band on the epiglottis,

3. And downwards to the cricothyroid membrane.

If such an extension be present lymphatic channels are invaded and metastasis, in that event, is probable. From this we may infer that the cords that are fixed offer the poorest prognosis. This statement is borne out by reports of St. Clair Thompson in which he states that 84 per cent of the cases with movable cords operated upon have a three-year cure, while only 44 per cent of the cases with fixed cords have a three-year cure, showing how necessary it is that the diagnosis be made before fixation of the cord is present.

Fortunately, intrinsic carcinoma of the larynx, even in a rather developed stage, is still a local process, as its location in the laryngeal box cuts it, to a considerable degree, from the lymph channels of the neck, and it commonly metastasizes in two directions, either posteriorly, through the esophagus, or upwards, towards the epiglottis and lateral pharynx.

When laryngeal carcinoma is found upon examination, the following factors aid in making the prognosis more optimistic: (1) the growth does not involve the posterior portion of the larynx; (2) the extension of the growth is downward and forward rather than upwards; (3) age of incidence forty to sixty years; (4) the usual slowness and superficiality of the growth.

Let us, at this point, remark that we can see only about one-third of the growth

by laryngeal examination and an estimation of the size must be made from this visible portion.
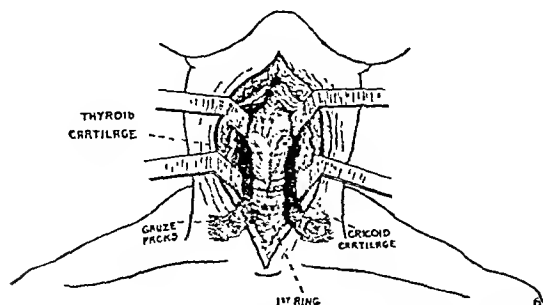
FIG. 1. First stage laryngectomy. Hyoid bone divided and retracted. Larynx and trachea skeletized. Gauze packs placed down to esophagus.

If, with all of these aids towards a conclusion, we still cannot arrive at a definite diagnosis, there is one other procedure to which we may resort, namely, biopsy. A biopsy should never be done unless the consent for a laryngectomy has been obtained, if the specimen proves malignant; and if indicated, the operation should be performed within three days of the date of biopsy. In taking a biopsy a piece of tissue should be removed by a sharp punch forceps, one bite being taken from the edge of the growth and another from the center, and great care should be exerted to avoid crushing, manipulation and bleeding. There should be a rapid examination of the tissue. However, this procedure is being used less and less and some strongly advise against it. Diagnosis is best made without biopsy because of the rapid spread of the growth afterwards.

Even when a diagnosis of carcinoma has been definitely decided upon, there is a group of pessimistic men who will not advise operation. Some object to the operation because of the loss of voice, though this is necessarily inevitable as the disease progresses, long before the fatal termination. Furthermore, those patients that have laryngectomy develop an esophageal voice from one to three months after the operation, which can be so trained that they are able to carry on such a profession as medicine or law.

Another objection frequently advanced is that there is no real recovery from the operation. The mortality is as low as 3
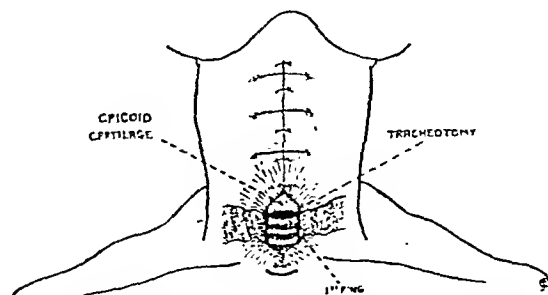
FIG. 2. Trachea opened and gauze packs replaced.

per cent. Patients become useful, active citizens, capable of continuing their life work, and of realizing, if not to its fullest, at least to a very large extent, the joy of living a rounded and enthusiastic life. They are not derelicts or operative curiosities, and are freed from the certain inhuman agony and suffering in the terminal stages of the disease, slow death from gradual suffocation. Whatever the means of relief in this condition, it is more than worth while.

I have no desire, at this time, to enter into a discussion with the specialist in this field regarding the advisability of inter-laryngeal operations, thyrotomy, hemi-laryngectomy, or other types of laryngeal operations advocated; but wish to discuss briefly two points: one, the use of radium, and two, laryngofissure, and then will confine the remaining remarks to important points in the care of a laryngectomy patient.

It is believed by most laryngologists that radium should be used in those cases that cannot be treated by surgery, or when, following surgery, there is a question of metastasis, for as yet surgery far surpasses any form of radium or x-ray treatment.

Laryngofissure, an excellent procedure in properly selected cases, is only suitable in incipient cases; and, unless the disease is diagnosed quite early, laryngofissure is not the operation of choice. In any event it should not be attempted in the following

conditions: (1) when the laryngeal growth is on the posterior third of the cord, because of proximity to the esophagus and

results are likewise imperfect. At present, for the great majority of the cases seen we should resort to laryngectomy.
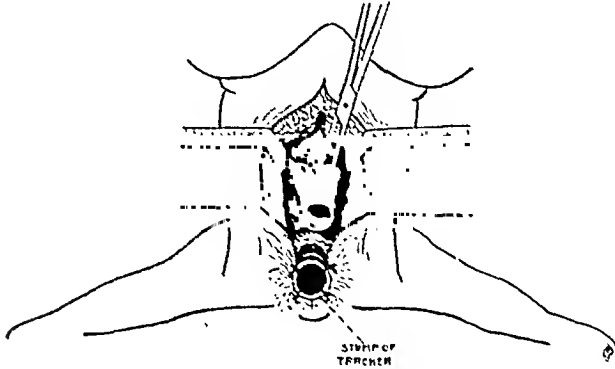
FIG. 3. Second stage laryngectomy. Trachea fixed to skin. Larynx removed from below upward.
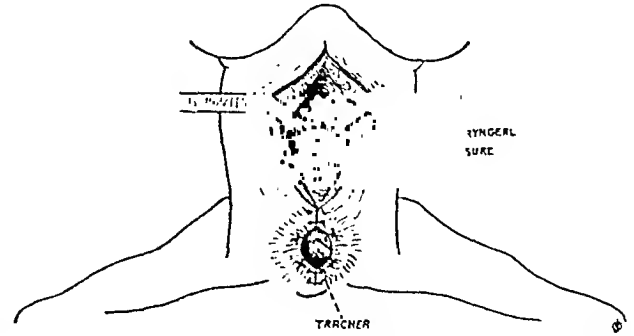
FIG. 4. Second stage laryngectomy. Pharyngeal closure completion of tracheal fixation.

the possibility of early metastasis and an unsatisfactory, incomplete removal; (2) with the growth in the anterior commissure crossing the midline; (3) or in rapidly growing cancers, of any size, posteriorly and especially in the young; (4) it should not be done in growths starting in the deep structures of the larynx; (5) in growths occupying over one-third of the cord; (6) never in bilateral carcinoma; (7) nor when the cricoid ring is involved; (8) nor in cases with complete fixation of the cord.

To sum up, laryngofissure should only be performed in very incipient cases in the anterior quarter of the cord, where a liberal amount of normal tissue can be excised with the growth, and even in some of the best hands, in localities best organized to treat the laryngeal carcinoma, there is a recurrence of the disease after laryngofissure in 35 per cent of the cases.

However, these incipient growths, which might be cured by laryngofissure, are very rarely seen in the average clinic. In most cases we are left to proceed with the good common sense advocated and the methods used in general surgery in the treatment of other types of cancer: namely, we "strike" wide of the disease to achieve a complete cure, and are dissatisfied with less than $\frac{1}{4}$ in. leeway of normal tissue in excision of the carcinoma. We know that it can only be killed with one shot, and the bull's eye must be hit; if the shot is not perfect the

The results from a laryngectomy are dependent upon the proper selection of cases, but even in some of the well-developed carcinoma we are able to obtain as high as 70 per cent five-year cures, with the incidence of recurrence less than 3 per cent. If not cured, the patient can be spared the intolerable, prolonged death from cancer of the larynx, and die in comparative comfort from metastasis. To swell your statistics cases can be refused; but to help your fellowmen, give them a warranted chance and the result will be astounding.

Operations for cases of carcinoma of the larynx should be done by an experienced general surgeon or specially trained laryngologist in the best equipped hospitals, with every facility of medicine and emergency aids at his disposal.

There is no other operation that needs such scrupulous attention to details as a case for laryngectomy. The preparation of the patient demands a rigid examination, study of chemical balance and metabolic rate, removal of foci, digitalization of the heart, a low protein diet, high fluid balance, and soda bicarbonate enemas for six to eight days before the operation. Two or three days before the operation a Refuss tube for feeding is inserted so that the patient may become accustomed to it before the operation. Rest, relaxation, and relief from worry are necessary, and the

patient should be in the best possible general health.

Special points in the operation are, local anesthesia by novocaine block and infiltration, and the avoidance of general anesthesia whenever possible. The larynx is completely exposed and laterally packed before the trachea is opened with the resulting contamination. A tracheotomy is done at a period of twenty-four to thirty-six hours after the initial procedure. The second stage of the operation is ten to fifteen days later, after all suggestion of reaction has subsided and the general condition has regained its reserve. The tracheal packing is then removed and the trachea is severed from the larynx and a tracheal skin union made by stay sutures, so as to give a permanent opening and fixation of the trachea that will not collapse. The insertion of the special tracheotomy tube prevents the blood from entering the trachea during the remainder of the operation.

The larynx is then dissected from below upwards, and by blunt and sharp dissection is dissected from the pharynx, leaving as small a stroma as possible which should immediately be closed by layer suture, while the remainder of the wound is closed with through and through suture with ample drainage of iodoform gauze and cigarette drains in the wound. The patient is put in semi-Fowler's position and the most careful nursing and postoperative regime followed out. No accumulation of serum or blood is allowed to collect in the wound or trachea, and this demands a highly trained nurse. The postoperative care should be done by the surgeon, as in most instances it calls into play all his surgical ingenuity, and unless he is ahead of the treatment of the condition it will certainly terminate fatally. After hospitalization for ten to thirty days the patient has healing of the wound, and when strength is regained can resume his usual activities. The period of voice training begins as soon as the feeding tube is removed, which is usually in about ten days, if the healing of the esophagus is primary. The amount of voice that is developed is dependent upon the intelligence and cooperation of the patient. The voice is effected by expansion and contraction of the esophagus; before speaking the patient aspirates air into the upper two-thirds of the esophagus, and with the trained contraction of the esophagus, air is forced into the throat. The voice is usually better when the stomach is full. In from one to four months the patient may train his voice so that he may carry on his usual profession. The use of artificial larynxes has been satisfactory in some cases, but not wholly so.

SUMMARY

1. Early diagnosis of carcinoma of the larynx is dependent upon the education of the public to the seriousness of persistent hoarseness in a person over thirty years of age, and an immediate recognition of the cause of this hoarseness.

2. Until carcinoma of the larynx is diagnosed in its incipiency, laryngectomy is the operation of choice, but should only be attempted by one skilled in the operation after meticulous selection, preoperative care and with untiring postoperative care, and persistent after-treatment and reeducation.

3. Laryngectomy can cure 70 per cent of intrinsic carcinoma of larynx with only 3 per cent mortality and about 3 per cent recurrences; returning to society self-supporting people able to carry on their usual work and enjoy a comfortable, useful life.

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EXPERIMENTAL STUDIES ON THE EFFECT OF
THE PROLONGED USE OF COLON ENEMAS UPON THE BOWEL IN ANIMALS*

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ENEMAS have been utilized for centuries for the relief of constipation as well as in the treatment of various affections of the bowel; but little attention has been directed, however, to the ultimate effect upon the bowel itself, following the prolonged use of this method of treatment. It is well known, that due to the immediate relief afforded as the result of enemas and irrigations, a habit is not infrequently formed and an abuse of this method of treatment not uncommonly occurs. In fact, in recent years, the all too frequent use of enemas as well as irrigations which are practiced not alone under the supervision of physicians, but by others as well has often led in our experience to the production of certain colonic affections as well as nervous intestinal disorders.

This may be brought about in some instances at least by lowering the resistance of the bowel by the habitual application of this method of treatment in consequence of which inflammatory changes of a more or less severe type are apt to follow.

On the other hand, colonic irrigations alone, rarely result in a distinct cure but in accomplishing their immediate effect often cause an interference with the normal function of the bowel.

Since but few scientific investigations on the effect of rectal enemata upon the bowel have been recorded, it seemed important to us that a further study of this problem should be undertaken. On this account we attempted to study in animals, the effects of frequent prolonged rectal injections of solutions commonly administered in the routine treatment of bowel affections as well as the effect of various chemical irritants on the colon.

In these experiments 34 male dogs of medium size were utilized. During this period the animals were allowed the usual

FIG. 1. Ulcerative colitis. Ulcer, occurring ninety-five days following use of sodium carbonate solution.

diet ordinarily consumed by laboratory dogs. It is important to call attention to the fact that the colon of the dog differs from the human in that it is extremely short, varying in length from 30 to 45 cm. and that the ileocecal valve is patent to such a degree that fluids when injected per rectum, pass freely into the small bowel. In a single instance, a barium enema was vomited almost immediately following its administration. On this account solutions introduced into the rectum produce a variety of changes affecting not only the large but also the small bowel as well.

In this study, the following solutions were administered rectally:

1. Plain water
2. Soap water

3. Cotton seed oil
4. Sodium carbonate solution
5. Neutral acriflavine solution

protoscopic and stool examinations were made. Pathological studies of the entire bowel were also made, following death.

FIG. 2. Same dog, microscopic specimen; ulceration undergoing extensive necrosis. Low power.
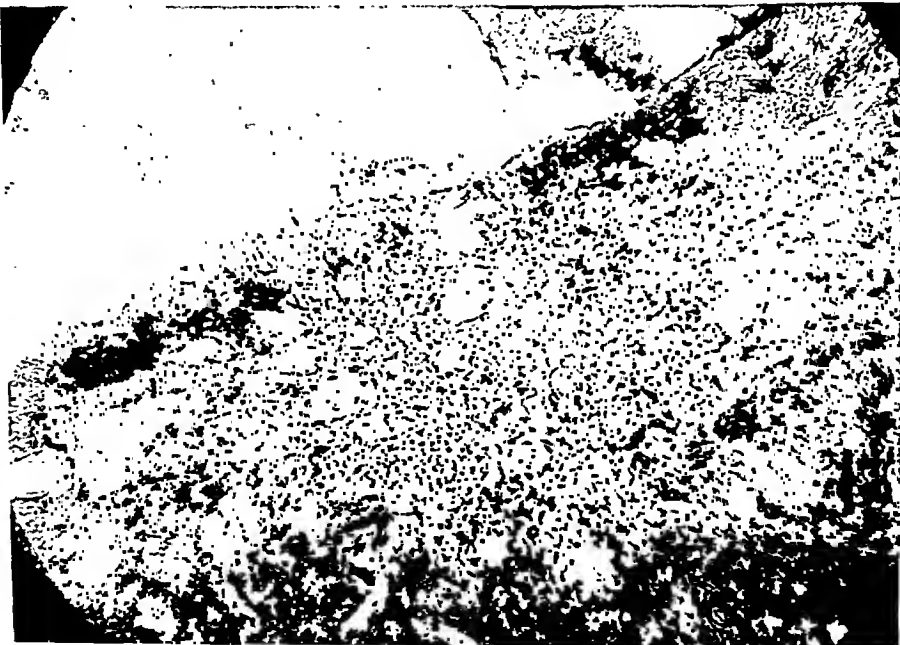
FIG. 3. Same dog. High power.

6. Camphor water
7. Ammonium chloride solution
8. Hydrochloric acid.
During the period of treatment, frequent

1. *Plain Water Enemas.* Three dogs were utilized in this experiment; 250 c.c. of tap water were injected once daily for 155 days. Following three months' treat-

ment proctoscopic examinations of the bowel revealed no abnormalities. After five months, the proctoscopic examinations

gallons of water, plain or medicated, as is not infrequently practiced not only distends the bowel but also causes hyperemia.

FIG. 4.   FIG. 5.

FIG. 4. Perforated ulcer of ileum following application of 0.5 per cent solution of dilute hydrochloric acid for thirty days. Blood and mucous observed in stools.
FIG. 5. Same dog, showing hyperplasia of Peyer's patches.

showed a slight redness of the mucous membrane. These dogs were killed on the one hundred and fifty-fifth day and the following pathological findings were noted. In one dog the gross as well as the microscopic, appearance of the various parts of the bowel revealed no abnormalities. In the second and third dogs, a congestion of the colon with hemorrhagic areas, 7.5 cm. from the rectum and 45 cm. above the cecum were observed.

It is interesting to note that Hirschman[1] calls attention to the fact that even plain water enemas may produce in man a very slight deviation from the pearly pink of the normal mucous membrane. He also suggests that the flushing of the colon with

These observations are in accord with our findings following the prolonged use of enemas in animals.

2. *Soap Water Enemas.* Three dogs were given soap water enemas for one hundred and twenty-nine days. In two and one-half months following treatment, the proctoscopic examination revealed a normal colon in 1 instance and a slightly inflamed mucous membrane in 2. One and one-half months later, the proctoscopic study showed the mucous membrane slightly reddened and glary, as the result of a plastic proctitis. On the one hundred and twenty-ninth day, these dogs were killed for pathological study. The bowel was found normal in 2 dogs and the colon

[1] Hirschman. *J. A. M. A.*, 89: 1039, 1927.

was congested and thickened in 1; the small bowel also revealed injected vessels.

Runge and Hartman[1] who studied the

FIG. 6. Constricted area in ileum, with perforated ulcer. This occurred under hydrochloric acid treatment.

effect of rectal injections of soapsuds, observed that ulcerations, hemorrhages and actual necroses were produced in rabbits within three days following the use of .5 per cent solution. According to Mond,[2] these lesions are dependent upon the destructive effect of the lipoid soluble molecule in the soap. Hirschman[3] likewise points out the irritating effect of soapsuds enemas on the mucous membrane of the bowel with the production of a proctitis in the human subject.

3. *Cotton Seed Oil Enemata.* Three dogs were utilized in this experiment. Three

[1] Runge and Hartman. *Klin. Wchnschr.*, 7: 2389, 1928.
[2] Mond. *Pflüger's Arch.*, 217: 313, 1927.
[3] Hirschman, *J. A. M. A.*, 89: 1039, 1927.

ounces of oil were injected rectally daily for one hundred and twenty-seven days. During all of this period, the stools re-

FIG. 7. X-ray of gastrointestinal tract following use of acid, showing marked hypermotility of entire intestinal tract following barium meal by mouth; note small amount of barium in stomach and stringing of small and large bowel.

mained normal. The dogs were then killed and the appearance of the bowels studied. In 1 instance, the entire bowel retained a perfectly normal appearance. In the other 2 dogs, a slight injection of the vessel was observed involving about 3 in. of the bowel above the anal orifice. The colon otherwise appeared normal. It is quite possible that these minor changes were produced by the irritation of the constant introduction of the hard rubber tube.

4. *Sodium Carbonate Solution.* A solu-

tion of sodium carbonate gradually increased in concentration from 5 to 20 per cent was injected rectally in 3 dogs. Two

FIG. 8. Small punctate areas observed in large bowel, due to hyperplasia of lymph follicles, following use of ammonium chloride solution.

of these dogs died as the result of the toxic effect of this chemical and one was killed. One died after sixty-three days' treatment and presented a congestion of the large bowel with marked hyperplasia of the lymphatics. The small bowel showed a hyperplasia of Peyer's patches. The second dog passed bloody stools on the one hundred and tenth day and died five days later. At autopsy, the large bowel presented hemorrhagic areas which extended into the cecum and lower ileum with areas of necrosis and sloughing. The lymphoid elements revealed a marked hyperplasia. A microscopic examination showed the following pathological changes. The epithelium presented various grades of degeneration varying from extreme swelling to

complete necrosis. In areas the mucous membrane showed sloughing with the formation of ulcers, the bases of which
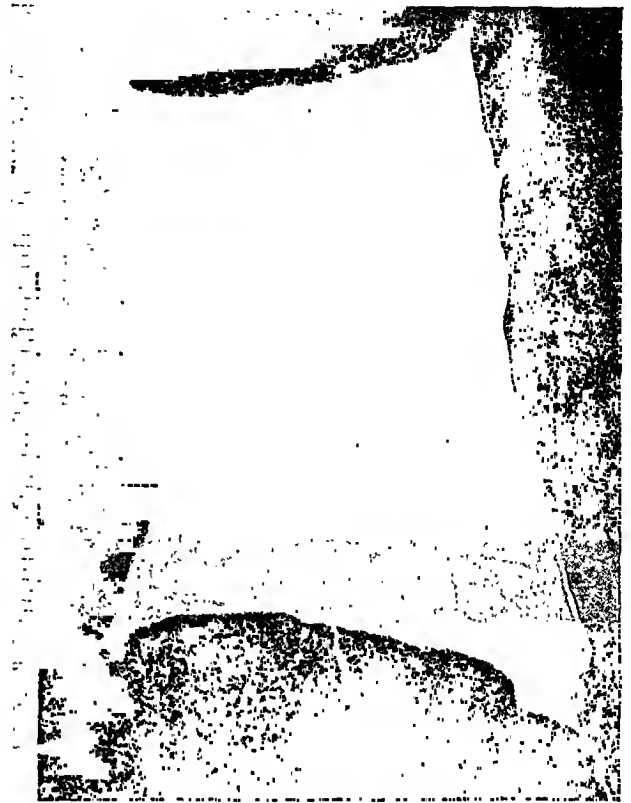
FIG. 9. Early congestion and injection of blood vessels, and also hyperplasia of lymph follicles under ammonium chloride treatment.

were formed by the submucosa. None extended as deep as the muscularis. The submucous tissue at the base of the ulcers contained many dilated blood vessels and many filled with red blood corpuscles. The lymphatics also were dilated showing diffuse lymphatic infiltration. Marked congestion and edema were observed throughout the section. The muscle was not involved. The pathological diagnosis indicated an ulcerative colitis.

The third dog was killed on the one hundred and seventy-fifth day. When proctoscoped on the one hundred and tenth day, the mucous membrane was found inflamed presenting hemorrhagic and denuded areas in the mucosa revealing the typical picture of an ulcerative colitis. The stools on a number of occasions showed blood and mucus.

5. *Neutral Acriflavine Solution* (1 to

3000). In two dogs, 3 oz. of a 1 to 3000 solution of neutral acriflavine were injected once daily for one hundred and

FIG. 10. Perforated ulcer in iliocecal region, following use of 1 per cent solution of ammonium chloride for one hundred and sixty-nine days.

fifteen days. The dogs were killed at this time. The appearance of the colon of one dog was normal while in the second dog, there were evidences of a slight hyperemia.

6. *Camphor Water.* Three ounces of a solution of camphor water (United States Pharmacopeia) were injected rectally into two dogs. One dog died after twenty-nine days, the autopsy revealing a marked thinning of the entire bowel. The large bowel presented black stripes running parallel with the bowel apparently produced as the result of pigment formation. Microscopically no abnormalities were revealed, the pigment disappearing as the result of the treatment in mounting the sections. The second dog was killed on the one hundred and eighth day and no abnormalities were observed.

7. *Ammonium Chloride.* Three dogs were injected rectally with ammonium chloride (10 per cent) solution once daily and died at periods of seven, eight and thirteen days respectively. At autopsy, the specimens showed moderate hyperplasia of the lymphoid tissue of the submucosa. An area was noted in which the mucous membrane was necrotic. Necrosis did not, however, involve the submucous tissue; on the other hand, in other areas, the necrosis destroyed the tips of the villi; while the deeper portion of the mucosa remained intact. Microscopically, the large bowel showed marked hyperplasia of the solitary follicles, the small bowel revealing hyperplasia of Peyer's patches. Inasmuch as rapid death was produced due to the toxic affect of a 10 per cent solution, weaker solutions of the same chemical were utilized, and it was observed that a similar effect occurred at periods varying almost proportionately with the strength of the solution.

Three dogs were injected with 3 oz. of a 1 per cent solution daily. After twenty-four days, one dog died and autopsy revealed changes similar to those produced with the 10 per cent solution. The other two dogs were killed after one hundred and sixty-nine days. Both showed blood and bloody mucus in the stools at various intervals. In one, a large perforated ulcer was noted in the ileum, just above the ileocecal junction and areas of inflammation were also observed.

8. *Muriatic Acid.* Eleven dogs were utilized in this experiment. In two, 250 c.c. of a 10 per cent dilute hydrochloric acid solution were injected rectally twice daily. Both dogs died on the third day following the administration of four enemas. The autopsy revealed extensive sloughing of the mucous membrane especially in the region of the cecum and terminal ileum. In these areas, the tissues presented a necrotic appearance with two large perforations in the ileocecal area in one instance and a single large perforation in the terminal ileum in the other.

Due to the rapid destruction of tissue and early death of the animals from the application of the solution given twice

daily, we decided to administer the same solution to three other dogs once daily. These dogs also died promptly following

Fig. 11. Lymphatic hyperplasia. Low power.

the use of two enemas. In two dogs large perforations were noted in the ileocecal region. In the third, extensive hemorrhages with necroses of tissue were observed in the ileocecal region. Inasmuch as the 10 per cent solution was too destructive, a 2.5 per cent solution was utilized in two dogs. All of the dogs died promptly following the use of a few enemas (three, four, and eight days respectively) presenting similar findings. A 0.5 per cent solution was now utilized in three dogs. The dogs lived thirty, fifty-three and sixty-one days respectively. The stool examination constantly showed blood and bloody mucus and the feces were diarrheic. These dogs also revealed perforations and necrosis at autopsy.

CONCLUSIONS

As the result of these experiments, the following conclusions seem justified.

1. The prolonged use of enemas seems to result in more or less bowel disturbance.

2. The use of even simple water enemas, when applied over long periods may produce mild inflammatory changes.

3. Soapsuds enemas are apt to produce

more marked inflammatory changes and even hemorrhages and ulcerations have been recorded.

Fig. 12. High power. This finding was constantly observed in animals treated with ammonium chloride and sodium carbonate.

4. Oil enemas appear to produce less irritation to the mucous membrane of the bowel.

Fig. 13. Peculiar pigmentation of large bowel which occurred in one instance following use of camphor water.

5. Acriflavine in 1 to 3000 solution and camphor water (United States Phar-

mocopeia) cause but slight disturbance of the bowel.

6. Irrigations with irritating chemicals such as sodium carbonate, ammonium chloride and hydrochloric acid, even in weak solutions cause inflammatory changes ranging from mild processes to extensive ulcerations and necroses.

7. Finally it appears obvious from these experiments, that the prolonged use of rectal injections and irrigations may result in the production of a variety of colonic affections of a more or less severe grade.

DISCUSSION

Dr. Soper: In regard to the vaccine treatment in these cases I wish to say that we have corroborated Bargen's results and would not do without the vaccine in the treatment of these cases. We have had fewer relapses since we have instituted the vaccine method. As Dr. Gaither emphasized many of these cases will be clinically cured but sigmoidoscopy will reveal lesions in the rectum and lower colon. Local treatment is always indicated and we have found that a 25 per cent solution of silver nitrate carefully applied to the swab which must not touch the anal canal, is very effective. Bismuth subgallate in heaping teaspoonful doses two or three times daily is also very useful in the treatment of ulcerative colitis.

Dr. Friedenwald's paper is very timely and I hope it will check the fad of colonic irrigation that is going about the country. We observed the irritation and inflammatory processes in enema users many years ago. In some severe cases of atony of the lower colon enemas are necessary. We have found the oil emulsion enema to be less irritating than any other form.

The formula is two quarts of warm soapsuds, 4 dr. of sodium bicarbonate and 4 oz. of mineral oil, well shaken up to form an emulsion.

Dr. Jones: I desire to call attention to one point in Dr. Friedenwald's paper which I think should be emphasized, and that is: where patients are advised to use enemas, the capacity of the colon should be known. In using our barium enemas we measure the exact amount of barium mixture it takes to fill the colon, because there are so many things that may occur in giving enemas that "crash the gates" of the ileocecal valve, washing colon contents up into the small bowel.

I want to mention, in connection with Dr. Portis' paper that the preparations of acidophilus milk are related to some extent at least, to the old Kephir milk, that we studied in the later '90's, and the early 1900's. We found that the gastric secretion is somewhat increased by taking them by mouth, and this may also happen with the acidophilus milk.

We must remember, also, that the age of the milk has something to do with it's action, the twenty-four-hour preparations are at times const.pating, while the forty-eight and seventy-two-hour preparations will favorably influence constipation. Several years ago I published a paper along this line making comparisons between fermented milk of one, two and three days' fermentation. It seems to me that the study of its effect upon the gastrointestinal tract as a whole, is worth while, as well as a study of its effects upon the colon.

Dr. Lichty: I would like to ask Dr. Feldman whether there was any effect upon the tonus of the colon, or any change in the size of the colon, after a long series of colon washings? I would also like to ask Dr. Portis what he means by the term "implantation"? Does he use any particular technique, or special method, either per rectum or per ovis?

THE GASTROINTESTINAL TRACT IN ANEMIA PERNICIOUS*

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THE relation of the gastrointestinal tract to pernicious anemia has been the subject of many clinical studies, considerable experimentation and much speculation. Our reasons for presenting further data bearing on this subject at this time are as follows:

1. A series of 150 patients have been studied in whom the diagnosis has been established by every known clinical procedure of value, including the therapeutic response to liver extract or desiccated stomach. All of these patients have been under observation in the hospital for a period of from a week to several months. Following discharge from the hospital, practically all patients have been observed at intervals for a length of time varying from a few months to several years.

2. In all patients a fractional test meal has been done and in about one-third of them the gastric contents were removed subsequent to the intramuscular injection of histamine.

3. The gastrointestinal symptoms were studied before and after a therapeutically induced remission.

As an introduction to the data which are to be presented, the following case history is cited as it illustrates many of the important points concerning the relationship between the gastrointestinal tract and pernicious anemia.

The patient was a physician, male, aged fifty-two, who had experienced the typical symptoms of pernicious anemia for two years before admission. The following were the interesting points relating to the gastrointestinal tract in his history: 1. His father, who died at the age of eighty, had suffered from recurring glossitis for many years, although there is no indication that he had an anemia or subacute combined degeneration of the spinal cord. A gastric analysis was not obtained. 2. Twenty-six or twenty-seven years ago the patient developed a diarrhea in the form of 1 or 2 watery stools daily with no other associated symptoms. This persisted for a period of twenty years. 3. As a result of this diarrhea the patient consulted a physician (twenty-six or twenty-seven years ago) and a gastric analysis was performed which showed a complete lack of free hydrochloric acid. This was repeated four years later and the same finding was noted. 4. Eight years ago the patient developed severe recurring attacks of glossitis which have continued up to the present date. 5. The diarrhea continued daily until about six years ago when the patient developed three rather rapidly recurring attacks of severe acute cholecystitis which led to a cholecystectomy. Following this operation all symptoms referable to the gall bladder immediately disappeared as did the diarrhea. Four years after the operation the characteristic symptoms and signs of pernicious anemia developed.

As an isolated case record this proves nothing; but when considered with collateral data pertaining to the gastrointestinal tract in pernicious anemia, it gives an accurate picture of what must be a fundamental relationship.

The data which are to be reported in this article have been assembled from a group of 150 consecutive patients with pernicious anemia who were studied in the Thomas Henry Simpson Memorial Institute for Medical Research during the past two and one-half years. Eighty-seven were males and 63 were females. The age limits varied from twenty-two to eighty years, but 86 per cent of the patients were between forty and seventy years of age and almost one-half were between fifty and sixty years of age. The following data relating to the gastrointestinal tract

were investigated in each patient: food habits, appetite, nausea, vomiting, distention, glossitis, condition of the bowels and abdominal pain. In addition, careful notes were made concerning the condition of the tongue and in each patient a fractional gastric analysis was made.

A consideration of the dietary habits of patients with pernicious anemia is of interest as Koessler and his associates[1] have suggested that the disease may result from an inadequate consumption of vitamins or a deficiency of their utilization. It is of some importance, furthermore, to determine if patients who develop pernicious anemia have consumed only small amounts of liver or excluded it entirely from their diet. All patients of this group have been asked in a general way concerning their usual diet and in 19 a more intensive investigation was carried out. A similar dietary history was obtained from 25 patients on the medical and surgical wards of the University Hospital for comparison as a control group. The latter were patients of approximately the same age, without an anemia, and in each instance there was no gastrointestinal disorder which might have influenced the choice of food. Special attention was given to the use of the following articles of diet: milk, fresh and cooked vegetables, fresh and cooked fruit, dark breads, liver and other glandular meats.* The results may be presented briefly as it is doubtful if they have a bearing on the etiology of the disease. There was a slightly greater use of milk by the control group, whereas the patients with pernicious anemia actually consumed more liver than the former; otherwise there was no significant variation between the two groups. In some instances patients with pernicious anemia had eaten a very poorly balanced diet over a period of years and it is entirely possible that this may have been a contributing although not an essential etiological factor of the anemia. These

* These data were collected by Mrs. Dorothy S. Waller, Dietitian of the University Hospital, who will make a more extensive report at a later date.

results are in accord with the study of Cornell[2] who concluded that persons who later developed pernicious anemia did not have any specific differences in their food habits from their associates who remained free from the disease.

In 60 per cent of the patients the appetite was poor, sometimes amounting to an actual aversion toward food, while in 10 per cent it was classified as fair and in 30 per cent it was normal. It is known, however, that at the beginning of a remission, spontaneous or induced, the appetite may even become ravenous; but as these patients came to the hospital during a relapse, this was not observed in our group of patients prior to treatment. It is of interest to attempt a correlation between the appetite and the level of the red blood cells. In order to do this, the red blood cell counts in 42 patients with pernicious anemia who had poor appetites were compared with the red blood cell counts of 42 patients with pernicious anemia who had good appetites. It is apparent that there is a general tendency to the development of anorexia as the red blood cell count falls, but there were notable exceptions to this. A number of patients with severe anemia had normal appetites while others with almost normal red blood cell counts had anorexia.

About 50 per cent of the patients had nausea and a similar percentage likewise had vomiting. In most instances these symptoms were of a mild nature and occurred at rather infrequent intervals. The two exceptions to this statement are that these symptoms may become prominent when they appear as early manifestations of the disease, or when they appear at the time when the anemia is severe.

Abdominal pain was present in about 25 per cent of patients, and it is usually vague, mild and not a prominent symptom. The patients usually characterize it as dull and either localized to the epigastrium or distributed diffusely over the abdomen. Some described this as a "heaviness"

in the upper part of the abdomen. This discomfort in our experience is most frequently associated with distention of the intestines with gas. That it is not referable to the gall bladder may be deduced from the fact that it usually disappears within a few days after effective therapy is instituted. Severe abdominal pain is rare in pernicious anemia and when it does occur should always excite the suspicion of gall bladder disease.

Our observations concerning the functional state of the bowels in patients with pernicious anemia are in accord with a number of previous reports[3,4] which emphasize the frequency of diarrhea. In our patients, however, constipation was the more frequent symptom as it occurred in about one-half of the patients whereas in 23 per cent of the patients the bowel movements were normal. The constipation cannot always be attributed to the pernicious anemia as in some instances it had been present for years preceding the disease. In a fair number of patients with advanced spinal cord changes it appeared as though a neurogenic factor might be of importance in the production of this condition. Recurring attacks of diarrhea occurred in 14 per cent of the patients and in an additional 15 per cent there were alternating attacks of diarrhea and constipation. Combining these figures it may be said that diarrhea occurred in 29 per cent of this group of patients.

A definite and convincing history of attacks of glossitis was obtained in 65 per cent of the patients, which raises this symptom to one of considerable importance. As has been previously emphasized[5] glossitis may occur some years prior to the symptoms due to the anemia or those associated with changes in the spinal cord. In our series this symptom occurred in a small number as the sole manifestation of the disease at a time varying from one to ten years before other characteristic symptoms occurred. In an additional group of patients it was among the earliest manifestations of the disease.

Careful inspection of the tongue in each patient of this group disclosed that 42 per cent had a definite and easily recognizable atrophy of the papillae, about which there was no doubt. An additional number showed questionable slight atrophic changes but these were not considered abnormal. In others there was a redness of varying degree noted and other changes of a minor nature, but these were not included in our statistics. It was of interest to note that a patient's tongue may appear perfectly normal despite a history of severe recurrent glossitis and on the other hand there may be obvious atrophic changes without a previous history of symptoms referable to the tongue. It is likewise true that a patient with true pernicious anemia in an advanced stage of the disease may have a perfectly normal appearing tongue and have experienced no symptoms of glossitis. Regardless of the emphasis which has been placed upon the association of glossitis with pernicious anemia, this is occasionally overlooked for in some instances the anemia has not been recognized and the glossitis has been treated locally or by some other measure, such as the removal of all the teeth. The effect of the modern treatment of pernicious anemia on the glossitis is of considerable interest for in a great majority of patients it causes this symptom to disappear very promptly. In a few, however, the glossitis may persist and constitute the patient's sole complaint and in others it may disappear following the initial treatment and recur at a later date when the red blood cell count is within normal limits.

ACHLORHYDRIA

For a great many years the work of a fairly large group of investigators has indicated that an achlorhydria exists in practically every patient with pernicious anemia. Our results amply confirm this statement for in 150 consecutive cases with the characteristic syndrome of pernicious anemia, there was an achlorhydria in every

single case. In 104 of the patients, gastric analysis was performed as follows: The gastric contents were removed after a fast of twelve to fourteen hours, after which the patient was given one shredded wheat biscuit and approximately 400 c.c. of water. Three specimens were then removed at one-half hour intervals. In the remaining 46 patients the procedure was varied somewhat as follows: After the usual preliminary fast of twelve to fourteen hours 1 mg. of histamine was injected intramuscularly. Immediately after the injections, the fasting contents of the stomach were removed. The patient was then given 300 c.c. of water and 4 or 5 specimens removed at intervals of fifteen minutes. The results in both groups were the same, as in each patient there was a complete absence of free hydrochloric acid and a uniformly low total acidity, the latter figure usually being below 10 per cent acidity, although in a few instances it was somewhat higher than this. Our experience has been in accord with a number of observers who have noted that examination of the gastric contents of patients with pernicious anemia, at a variable time prior to the appearance of the symptoms due to the anemia or spinal cord changes, has always shown an achlorhydria. In one patient of our group the achlorhydria was noted twenty-six years and in another ten years before the other manifestations of the disease. Of equal interest is the fact that with proper treatment the other symptoms disappear but the achlorhydria persists. This statement supports the work of Johansen[6] who examined 19 patients to determine this point. There are, however, 2 cases in the literature[7,8] in which free hydrochloric acid is said to have appeared in the gastric contents after recovery following the use of liver.

Concerning the achlorhydria in pernicious anemia it seems fair to state definitely that:

1. A patient has never been observed who had free hydrochloric acid in the gastric contents and later developed pernicious anemia.

2. A patient with pernicious anemia practically always has an achlorhydria. This statement is supported by our 150 cases and the reports of numerous other observers. It is possible that the few instances in which an achlorhydria has been observed, may be accounted for by a technical error, or an erroneous diagnosis.

3. Free hydrochloric acid rarely, if ever, occurs in the gastric contents in patients with pernicious anemia after the successful treatment of the disease and a disappearance of all symptoms.

THE CAUSE OF THE GASTROINTESTINAL SYMPTOMS

In studying the cause of the gastrointestinal symptoms in pernicious anemia the following must be considered:

1. The anemia;

2. The achlorhydria;

3. A neurogenic factor associated with spinal cord changes;

4. Infection of the gall bladder;

5. An intrinsic, as yet unknown, factor involving the gastrointestinal tract which may be the fundamental etiological basis of the disease.

The anemia may have some relationship to the gastrointestinal symptoms as there is a tendency for the latter to become more pronounced as the red blood cells and hemoglobin fall to a low level. That it is not the sole factor which is involved may be deduced from the fact that some patients with a low red blood cell count have no gastrointestinal symptoms, while in others with almost no anemia, the nausea, vomiting, diarrhea and anorexia may be pronounced. The strongest evidence in favor of a lack of correlation between the anemia and gastrointestinal tract is the fact that within a few days after effective treatment has been instituted, almost all of the gastrointestinal manifestations usually disappear although at this time there is ordinarily no significant change in the total red blood cell count.

Likewise there is no convincing evidence that the achlorhydria is the cause of the gastrointestinal symptoms. This is apparent from the fact that many otherwise normal individuals with achlorhydria are symptomless and further because many patients with pernicious anemia may be symptom-free during a spontaneous or therapeutically induced remission, although the achlorhydria persists.

Some years ago Jones and Joyce[9] suggested that chronic gall-bladder disease might be related etiologically to pernicious anemia and reported 13 cases in support of this theory. Although definite colecystitis may occur in patients with pernicious anemia, this is not common in our experience as the incidence is probably no greater than it is in a similar age group without pernicious anemia. Likewise the sudden disappearance of symptoms in most patients following treatment suggests that the underlying pathology is a transient rather than a more or less permanent change such as a cholecystitis.

Any statement concerning the neurogenic origin of the gastrointestinal symptom in pernicious anemia must be chiefly speculative in nature at this stage of our knowledge. It is our impression that patients with advanced spinal cord lesions have a tendency to constipation and abdominal distention which may be on a neurogenic basis. Some of our patients with advanced subacute combined degeneration of the spinal cord have complained of numbness in the rectum and fail to have the sensation of an impending bowel movement, with resultant incontinence of feces. It is unlikely that changes in the spinal cord or the nervous control of the bowel is the sole cause of the gastrointestinal symptoms as these manifestations may be present without definite evidence of spinal cord involvement.

The final consideration deals with the possibility that the gastrointestinal symptoms are evidence of an intrinsic defect of the gastrointestinal tract, probably confined to the stomach which is the fundamental cause of the disease. Evidence in support of this theory may be summarized as follows:

1. The fact that an achlorhydria precedes the anemia, that it is practically always present at the time of the anemia and remains after the blood has reached normal limits.

2. The occurrence of a severe anemia after operative removal of the stomach. There are now a number of authentic cases on record[10,11] where this has occurred.

3. The occurrence of anemia in gastrectomized dogs as reported by Ivy.[12]

4. The remarkable experimental observations of Castle[13] which throw more light on the etiology of the disease than any other known studies. This investigator demonstrated that the action of normal gastric juice on beef muscle liberates a substance which is capable of relieving the anemia of pernicious anemia promptly in a manner similar to liver or desiccated stomach. From these statements it seems logical to conclude that some unknown change in the stomach results in a functional deficiency which is the fundamental cause of pernicious anemia.

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DISCUSSION

DR. IRVING GRAY: Several of our patients with pernicious anemia developed a symptom complex suspicious of coronary artery disease. In the last 6 patients studied, we have done repeated fractional gastric analysis and studies of the urinary alkaline tide and at no time have we found any free hydrochloric acid in the stomach (using all known gastric stimulants) nor have we found any change in the pH of the urine. In 3 patients with a rather marked and progressive pernicious anemia, we recovered neutral red in the stomach after the dye had been injected intramuscularly. After the bile present in the gastric contents had been removed, we acidified the filtrate with dilute hydrochloric acid and we thus produced a deep red color. In 1 patient, the gastric contents contained a great deal of the dye but no bile. Examination of these contents for pancreatic ferment showed them to be present. The finding of neutral red in individuals, who have pernicious anemia may be accounted for by the regurgitation from the duodenum into the stomach.

DR. SMITHIES: I would like to know if any tests have been made upon the liver function, not only secretory but also the other functions of that organ. It seems to me that, aside from the dietetic test, we have never had any very efficient tests for these patients in order to guide our medical treatment.

There are sometimes instances of cancer of the stomach where the blood is typical for pernicious anemia. I remember of Dr. Frank Billings and Dr. Bevan holding, at one time, a borderline clinic, in which the purpose was to demonstrate the efficacy of splenectomy in the treatment of pernicious anemia after a long discussion, the surgeon opened upon a large carcinoma of the greater curvature of the stomach. One should always rule out carcinoma in instances of pernicious anemia, particularly when they seem of textbook type. I have never seen cord changes with cancer, and often their pressure is a most important differential sign.

DR. SOPER: I think we all agree with the doctor's conclusion, namely that liver treatment does not always clear up these cases. This is particularly true in regard to the cord symptoms. Quite often we note that the blood returns to normal but that the pains in the hands and feet and difficulty in walking are increased. We have found high vitamin feedings to be useful in cases of this character.

As regards achylia gastrica all the older gastroenterologists have had patients under observation for a long period of years, twenty-five or more, without the development of anemia or any serious defect in nutrition. The secondary anemia and malnutrition that sometimes occur in achylia gastrica may often be traced to a chronic catarrhal enteritis. Dr. Adolph Schmidt emphasized that the nutritional state of the achylia patient depends upon the integrity of the mucosa of the small intestine. The diagnosis of chronic enteritis is readily made by careful feces analysis.

DR. GAITHER: Years ago, I had the privilege and pleasure of hearing Dr. William Hunter deliver a most interesting and helpful lecture on pernicious anemia. In the course of his talk, he emphasized the importance of noting, from the patient's history and physical examination, a glossitis or sore tongue; very often he had noted such a finding, which preceded by as much as two or three years, definite evidence of pernicious anemia.

Several years ago, it was brought out in the examination of a patient who consulted me, that he was suffering from a sore tongue; the blood-examination was entirely normal, but I urged the patient to return from time to time for further blood-examination, and warned him of the possibilities of the case. Many months later, he presented himself, so changed that I did not recognize him, and upon examination, proved to be a typical case of pernicious anemia. I present this instance in order to emphasize, as did Dr. Hunter, the importance of observing the condition of the tongue, even in the absence of blood-findings which might be indicative of pernicious anemia.

Dr. Ivy: Are there any cases on record in which women, with pernicious anemia, have become pregnant?

Dr. Isaacs: There is one thing which surprised us very much, as we studied these cases, and that is the total change in the gastro-intestinal symptoms, especially the change in the appetite which comes about within four or five days after taking the liver extract, or dried stomach. There is one sign which is almost certain to appear, and we have called it, somewhat facetiously, the "positive toast test"; some morning, usually about the fourth or fifth day after we have started this treatment, the patient will ask the nurse for an extra slice of toast with breakfast, and that same morning, we usually find a rise in the number of young red blood-cells. This occurs before there is an appreciable increase in the red-blood cell count.

You will recall that, in many cases, it is believed that this condition is caused by bad teeth, and many of our patients have had all of their teeth removed, and they were unable to make as good progress as the others. We feel that removal of all the teeth is a bad thing, and sometimes think that the symptoms are seriously accentuated by it, and we are inclined to believe that it is an additional factor in producing the digestive symptoms which we see, and which might not be so bad if the teeth were let alone.

As to the cause of the constipation when cord symptoms are present, we think it is probably related to a loss of the sensation. When these symptoms are present, we have a loss of sensation in the joints, a loss of sensation in the bones, and, probably, a loss of sensation in the intestines, so that the intestine is no longer able to feel the presence of the food or its contents, and therefore there is a stasis, with the production of constipation.

Cathartics which increase the intestinal bulk have no effect, nor have those cathartics which affect the sensation of the intestines. However, cathartics which act directly upon the muscles of the intestines will cause a movement promptly, such as, for example, pituitrin.

Dr. Lueders: I think it is generally accepted that anorexia, in pernicious anemia is important as a symptom, and I think that its disappearance, following the administration of liver extract, is due to its high content of vitamin B. I believe, also, that the severe abdominal pain

which disappears, is influenced by the high B vitamin content.

I would like to ask Dr. Sturgis, in estimating the cord changes, what size tuning fork does he use to get the most delicate vibration sense?

Dr. Sturgis (closing): Dr. Gaither's point concerning a persistent glossitis has interested me very much. Any patient with such a complaint should be carefully observed from the standpoint of pernicious anemia which means that at least a careful study of the blood and a gastric analysis should be obtained. The glossitis may be the earliest symptom and occur at a time when the blood is normal; but if the patient is in the initial stage of pernicious anemia there will be no free hydrochloric acid present in the gastric contents. One characteristic of the glossitis is a tendency for it to appear periodically.

Now, as to the point about the vitamins. It is true that commercial liver extracts contain a large amount of vitamin B but I do not believe it is responsible for the beneficial effects which are produced in pernicious anemia. In the first place, striking results have been obtained in pernicious anemia by administering a highly purified extract which is free from vitamin B and, secondly, the feeding of vitamin B alone has no specific effect in pernicious anemia. It was suggested at one time that the increased appetite which followed the use of whole liver resulted from a lowering of the blood sugar but this is not so, as the appetite improves before a definite drop in the blood sugar can be demonstrated.

With reference to Dr. Ivy's question concerning pregnancy in women with pernicious anemia who have been restored to normal with liver treatment, let me say that I have not observed such a situation as a very large majority of patients with the disease are past the child-bearing age. I have heard of one patient who became pregnant after treatment with liver extract but I have not learned the subsequent history of the case.

It is entirely possible that some of the abdominal symptoms, especially those referred to the epigastrium, may be of an anginoid type, although in our experience they have not had the characteristics of this kind of pain. Dr. James B. Herrick of Chicago has emphasized the importance of anginoid pain in patients with severe anemia.

I am sorry that I cannot answer Dr. Smithie's

question as we have not carried out extensive tests for liver function in our patients. In a fairly large group we have taken x-rays of the gall bladder with the improved technique but we are unable to draw any definite conclusions from them.

We have been greatly interested in the differential diagnosis between pernicious anemia and cancer of the stomach. Ordinarily this is not difficult but occasionally an interesting situation arises. A few months ago, a man of middle age was admitted with a history of loss of weight, pallor and persistent vomiting. Physical examination disclosed emaciation and a striking pallor. There was a severe anemia which was typical of the pernicious anemia type. Gastrointestinal x-ray series gave the characteristic pictures of carcinoma of the stomach. Even though we concluded that the patient had cancer, it was decided to give him desiccated stomach as the peripheral blood was so typical of pernicious anemia. There was an immediate and striking response to the treatment and within a few weeks the blood was normal and the patient was entirely well. A repetition of the gastrointestinal series disclosed a normal gastrointestinal tract. The only conclusion which could be made was that the first x-ray studies were incorrect and that the patient had a true pernicious anemia. I think it is worth while, therefore, to try the treatment of pernicious anemia in any patient who has the picture of a primary anemia in the peripheral blood, regardless of the other findings.

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*Continued from p. 15.

PUSH FLUIDS

THE SURGEON'S POSTOPERATIVE ORDER *

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CHICAGO, ILL.

THE fear of dehydration has swept the country. Starting with treatment of dehydration fever of infants, followed by the recognition of dehydrated states before and after operations, and in infections, a universal use and frequent abuse of excessive fluid intake have become a routine practice in most hospitals. For some years I have been observing with interest the often useless and frequently harmful procedure of pouring solutions through various orifices into patients. Often the mechanics of water retention and water excretion are fully ignored and pathologic conditions are aggravated.

The movement of ingested water from the point of entry to the time when it is excreted through kidney, lung, intestinal canal and sweat glands is not easy to follow. There are many controversial points, which lead into the much discussed subject of edema. But there are certain simple, unassailable facts which are so often disregarded, that their emphasis here is perhaps not unnecessary.

Nature has provided safeguards against water intoxication[1] in man. The sensation of satiety, of fullness after moderate amounts of water, the regurgitation and vomiting after gastric distention, the diarrhea and diuresis which follow ingestion of large quantities all serve to maintain the excretion in balance with excessive intake. It must be remembered, however, that the helpless patient into whom fluids are forced through non-physiological channels and whose water excretion might be handicapped by cardiac, renal or some local factors, may very easily develop a positive water balance with such retention as may have serious consequences.

1. *The Cardiac Factor.* Patients with myocardial damage show the same diuresis as normals after fluid intake, so long as they are in a stage of compensation; however, as one of the early signs of decompensation the water excretion is delayed. Retention occurs during the day and during the night there is a characteristic nycturia. At the same time the increase of weight in cardiac patients between morning and night as Gönczy[2] showed, reveals a latent edema, which so long as the horizontal rest in bed helps to excrete it, disappears next morning. If decompensation is further advanced, the patient continues to put on weight from day to day and becomes obviously waterlogged.

So long as a patient is in the upright position, or sleeps in a chair at night, the edema shows in the dependent parts of the body. The fact that cardiac asthma frequently occurs in waterlogged patients when they lie down, leads to the assumption that pulmonary edema, because of an overloading of the pulmonary circulation, is a factor in the case.

It is undoubtedly possible in a surgical patient, whose cardiac insufficiency is barely compensated, to produce a decompensation with edema and dyspnea by forcing fluids. When the protective water-depot in the liver runs over, the pulmonary circulation is suddenly overcome with fluid. A case in point was seen some years ago.

A woman sixty-five years old had a thyroidectomy performed for chronic hyperthyroidism. She had myocardial damage and auricular fibrillation. Following thyroidectomy 7000 c.c. of normal salt solution were given daily subcutaneously and partly as a Murphy drip. She developed a pulmonary edema which was interpreted as postoperative bronchopneumonia and died on the fifth day with signs of cardiac failure. There was a marked decrease in urinary output. No autopsy was performed.

It is hard to say how much the forcing of fluids had to do with the fatal outcome, but that it must have meant an increased load on the damaged heart, was shown by the edema and the gradually decreasing urinary output following operation.

2. *The Renal Factor.* It is generally known from the widely applied concentration-dilution test, that a large intake of water such as 1500 c.c. is followed normally by an increased hourly output of urine, with lowered specific gravity. In the presence of renal insufficiency, the hourly amount of urine will not rise to the same degree, and the specific gravity remains fixed. An isosthenuria as described by Volhard ensues. Obviously if fluids are pushed in a patient with kidney damage, water retention must result. And yet the practice of pushing fluids to an extreme in old prostatics, who have often an ascending pyelonephritis, in addition to their hypertension, nephrosclerosis and cardiac damage, is common enough.

A seventy-one year old patient with prostatic hypertrophy and 150 c.c. of bladder retention was admitted, septic and dehydrated. Suprapubic drainage was instituted, and an order was given by the urologist to give 4000 c.c. of normal salt solution a day. The patient's condition improved very rapidly, but on the fourth day the legs became edematous and uremic symptoms developed. Reduction of fluids promptly relieved the patient, who later made an uneventful recovery after a two-stage prostatectomy.

Water retention was probably due here to both cardiac and renal factors and possibly a third factor, which I will discuss under the next heading.

3. *The Salt Factor.* When patients with kidney insufficiency are given sodium chloride, sodium bicarbonate or other salts in doses of 15 to 20 gm. a day, their weight increases because of water retention. The degeneration of kidney tubules results in a diminished ability to excrete salt in larger quantity or higher concentration. The retained salt will cause under certain ion-concentrations a water reten-

tion. When we push fluids into a patient, we must decide whether we want to have it retained or excreted. The customary 4000 c.c. of normal salt solution a day represents 40 gm. of sodium chloride. This is at least twice as much as our normal daily intake of salt. Such medication will make the patient even more thirsty because of an elevation of blood chlorides. If fluids are given in greatly dehydrated patients with low blood chlorides and upper intestinal obstruction, the normal salt solution is rational. In other cases, however, the sole administration of salt solution easily leads to water retention, particularly if a degenerative kidney lesion will prevent a normal salt balance.

There is another important reason for not giving sodium chloride solutions in larger quantities. The sodium-calcium-potassium balance of the blood suffers by an overdose of the sodium-ion. As early as 1907 Rössle[3] described colloid changes in the heart muscle of patients who had received intravenous normal salt injections. Such injections accelerate metabolism, may cause glycosuria and fever, merely because of the excess of sodium in the solution. For this reason, it is advisable to administer Ringer's solution, which contains in addition to sodium, potassium and calcium in the same ratio as in the blood.

4. *Pathologic Changes in Tissues.* Following head injuries, there is a cerebral edema and a rise in cerebrospinal pressure. The importance of restricting fluids following head injuries has been recently stressed by Temple Fay.[4] Obviously such a condition calls for dehydration with 50 per cent dextrose or magnesium sulphate. Pushing fluids at the same time annihilates such an effect and is distinctly harmful.

W. H. S., aged twenty-six, healthy, vigorous male, sustained a head injury with temporary loss of consciousness but no clinical or x-ray evidence of a skull fracture. When brought to the hospital the patient seemed dazed but not unconscious, pulse 80, respirations 14. The blood pressure was 120/80. The attending

man made a lumbar puncture, following which the patient became brighter, and respirations rose to 26. Fluids were pushed by rectum and under the skin totalling 4000 c.c. of normal salt a day. At the same time 50 per cent dextrose solution was given intravenously. The patient relapsed into a semicomatose state for the next three days. When he was seen on the fourth day, a restriction of the normal salt solution to 500 c.c. daily with continuation of the hypertonic dextrose injections was suggested. The patient showed marked improvement and left the hospital in three weeks with no detectable residual symptoms, except a slight lag in the adrenalin curve.[5]

The beneficial effect of dehydration or fluid restriction in preventing or mitigating pulmonary edema is well known. That pneumonia is characterized by a marked retention of sodium chloride and binding of a great deal of fluids is evident. Postoperative atelectasis which, according to Brunn, occurs more frequently than is usually recognized, can be converted into a pulmonary edema.

The following case illustrates the possibility of harming pulmonary circulation, when it is already embarrassed by a massive atelectasis.

A patient forty-six years old had a smooth cholecystectomy for an infected gall bladder with stones. On the second postoperative day a sudden rise in temperature occurred, with physical signs of a massive lung collapse. As she did not retain anything by mouth, fluids were pushed by rectum and subcutaneously, totalling 4000 c.c. of normal salt solution. In spite of the fluid intake the urinary output did not exceed 500 c.c. a day, and an increasing liver dullness was noted. On the fifth postoperative day, the patient manifested a sudden attack of dyspnea, which persisted during the whole day. The attending men diagnosed pulmonary embolism. When I examined the patient at the end of the day, the dyspnea was diminishing, the liver dullness was decreasing and a sudden diuresis set in. Obviously the venous block mechanism of the liver had given way, flooded the right heart with blood and resulted in an overload of pulmonary circulation. That pulmonary edema could more readily develop in a previously atelectatic lung

is a possibility. On the other hand, pulmonary congestion may favor pulmonary infarction.[6]

THE NUTRITIVE VALUE OF FLUIDS

Many patients are unable to take anything by mouth after operation for several days. The consequence of such starvation is acidosis, with appearance of acetone in the urine. Administration of normal salt solution or even Ringer's solution does not improve acidosis. When dextrose is given in adequate amounts the glycogen storage of the liver is reestablished and acidosis disappears. The administration of dextrose solutions has been of great benefit and I feel, that as every operation, particularly under general anesthesia results in a temporary acidosis, the postoperative and if indicated the preoperative administration of dextrose solutions is advisable. It not only combats acidosis, but supplies calories. One hundred grams of dextrose can easily be given a day. Insulin does not seem necessary, unless the patient is diabetic.

METHODS OF ADMINISTERING FLUIDS

Of the 3 customary methods of administration, namely subcutaneous, intravenous and rectal, the last named, in my mind is most open to criticism. In the case of dextrose, there is a grave doubt that anything is absorbed through the colonic mucosa. McNealy's experiments on dogs are extremely suggestive in this respect.[7] Objection must also be made of adding such an excellent medium as dextrose to the lower intestinal flora, where gas-forming bacilli are known to be abundant and increase distention. A controlled experiment is cited to show the effect of rectal glucose. (See Graph.)

M. Sch., aged forty-one, had been in the ward with a joint-mouse in the left knee joint (osteochondritis dissecans). He had never complained of any gastrointestinal disturbance and seemed to be in perfect physical condition. He was put on a diet of C_{120}, P_{60}, F_{150} and food was served at 8.15, 11.30 and 5.30. Three experimental periods were obtained. On the

first day the weighed diet was served and blood sugar determinations were taken at frequent intervals. On another day, all other

This case illustrates a possibility of producing abdominal distention by the rectal drip with dextrose. Furthermore, as

Wm. Sch. Age 42
Diet: C120, P60, F150
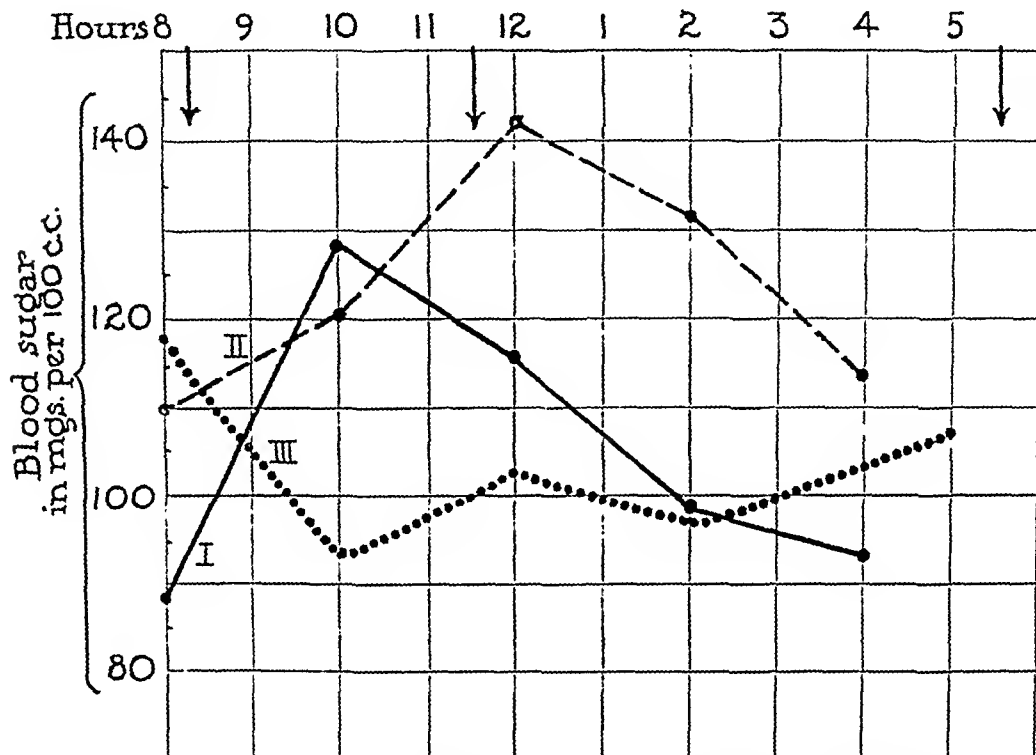
THE EFFECT OF SUBCUTANEOUS AND RECTAL ADMINISTRATION OF DEXTROSE ON THE BLOOD SUGAR LEVEL

Arrows indicate feedings at 8:15 A.M., 11:30 A.M., and 5:30 P.M. Curve I, straight line indicates blood sugar curve when diet of C120, P60, F150 was served and no dextrose was given. Curve II, interrupted line indicates blood sugar level, when patient received 1000 c.c. of 5 per cent glucose solution under skin. Same weighed diet was given. Curve III, dotted line indicates the blood sugar level when patient received 1000 c.c. of 5 per cent glucose by rectum. Both drips started at 10 A.M., and stopped at 1:00 A.M. Note low level of third curve indicating either a sudden mobilization of insulin, but more probably an interference with intestinal absorption due to distention.

conditions being equal, he was given 1000 c.c. of 5 per cent dextrose under the skin. On the third day, he was given 1000 c.c. of 5 per cent dextrose by rectum. Both subcutaneous and rectal drips were started at 10 A.M. and so regulated that they were completed at 1 P.M. From the table it will be seen, that on the control day, the breakfast caused the greatest fluctuation in blood sugar, but that the sugar level was fairly constant. On the second day, the subcutaneous dextrose gave a definite rise, two hours after it was started. On the day of the rectal drip, there was no elevation of blood sugar. The patient, however, became markedly distended, and it is possible that intestinal absorption was interfered with.

the blood sugar values did not rise after the rectal administration, as they did after the subcutaneous, there either was no absorption of the dextrose or there was such a rapid storage in the liver, that no excess of circulating sugar remained and utilization was increased. While this single experiment leaves room for both interpretations, it is very unlikely that such rapid absorption and utilization take place. In operating on diabetics, I have noted on two occasions, that whenever dextrose was administered rectally, and doses of insulin were given to help utilize it, insulin reactions occurred and the

insulin dosage had to be rapidly reduced, as the rectal sugar had not been absorbed and thus an excess of insulin was present.

Besides the probability that very little glucose is absorbed from the rectum and that colonic distention may be increased, a third factor speaks against the use of any rectal drip following abdominal operations. It is known that postoperative intestinal paralysis results not only in a distention of the bowel with gas, but in an accumulation of fluid. Following operations one can syphon off a considerable amount of fluid from the rectum. Obviously, when the bowel is distended, gases and fluids are not absorbed, as the venous backflow from the intestine is interfered with. To fill up such a colon with an additional 1000 or 2000 c.c. of tap water or normal saline solution does not seem logical. I believe that the extensive use of rectal drips has greatly contributed to postoperative abdominal distention, and prefer not to use it at all, if the necessary amount of fluid can be given through other channels.

THE INTRAVENOUS ROUTE

Intravenous administration of fluids has much to speak in its favor. Its action is rapid and independent of the rate of absorption. When the circulation is depressed or the volume of circulating blood is diminished as in shock or hemorrhage, it quickly restores the necessary amount of fluid. There are nevertheless some drawbacks to intravenous administration. In the first place, reactions still occur in spite of the most scrupulous care in preparing the solutions and selection of tubing. Particularly the dextrose solutions may contain some protein, which produces typical parenteral protein reactions. I always use 50 per cent dextrose solutions from ampules, which are diluted in triple distilled water in 5 to 10 per cent concentrations. One to three thousand cubic centimeters of 10 per cent dextrose can be easily given intravenously during the day, and the dextrose thus administered is the best safeguard against acidosis.

One must distinguish between the dextrose solution given for dehydrating purposes, as in head injuries or acute pulmonary edema, and the dextrose which is given for purposes of utilization. In the first case, 50 per cent solutions are given, which start an intense diuresis, the dextrose being excreted with urine. In the second case, the concentration should not exceed 10 per cent, and the dextrose must be given so slowly that none is excreted. If the rate of utilization of dextrose given intravenously is approximately 1 gm. per kilogram body weight, per hour, not more than 65 to 75 gm. of glucose can be given in an hour. One thousand cubic centimeters of 10 per cent dextrose solution must be given in about an hour and a half, otherwise much of the ingested sugar will pass through the kidneys. One should always administer dextrose by an intravenous drip method. While I have only limited experience with Hendon's intravenous needle, his method of venoclysis[8] seems to fulfill all requirements of simplicity and efficiency.

When cubital veins are impossible to find, the saphenous vein might be helpful. But all these procedures, while simple enough in a large hospital with plenty of trained assistance, might become cumbersome and time-consuming elsewhere. Besides, the prolonged intravenous administration may favor thrombosis. I have used the saphenous vein of a diabetic child for four days, leaving in the needle continuously, without producing any thrombosis. Yet one cannot call this administration an ideal one, as a thrombosis could be precipitated.

I have left the simplest and safest method to the last, the subcutaneous drip which is simple to manage. If usual precautions of sterility are observed, and the ingested fluid is kept at a reasonable temperature, there will be no reactions. Three thousand cubic centimeters of fluid can be given, using the region under the breasts and thighs without any difficulty. If another 1000 c.c. must be given, and usually 3000 c.c. are plenty, it can be given intravenously. Of the 3000 c.c.

2000 c.c. are usually a 5 per cent dextrose solution, while the other 1000 c.c. are Ringer's solution. This gives the patient 100 gm. of dextrose and about 7 gm. of sodium chloride, which is usually sufficient for the first three days after operation. There are of course definite indications for more sodium chloride, as in high intestinal obstruction; it might also be necessary to restrict the salt to less than 7 gm. in certain types of kidney damage. It may be advisable to increase the dextrose intake for its nutritive value. But in the average major postoperative case, such quantities seem sufficient.

The great objection to subcutaneous drips, is the patient's discomfort. This is a very serious objection, even if otherwise the method is most simple and effective. One can and should anesthetize the skin with novocaine, use very fine needles, and change the needle's position frequently to avoid over-distention. The rate administration should largely exceed the rate of absorption. The dextrose solution must be 5 per cent, never more nor less and does not cause any tissue irritation. If for some reason the subcutaneous drip is not tolerated, there still remains the intravenous to use. Rectally only tap water is given, never glucose, and even that is avoided in abdominal distention.

The time to start liquids by mouth will vary according to the type of anesthesia, to the type of operation performed and postoperative complications. But when a patient is nauseated, or has vomited once or twice and shows increasing gastric distention, all fluids by mouth should be stopped and a permanent gastric drainage should be instituted with a Rehfuss tube, as outlined by Kanavel and Koch.[9] I have seen many a paralytic ileus recover under such management.

COMMENT

The foregoing reflections barely scratch the surface of important problems. But it is time for the surgeon to approach the physiologically trained internist for more help in postoperative management. Most of these problems touch fundamental principles of circulation, kidney function, water and salt metabolism, tissue thirst, nutrition. Few surgeons could ever delve into such a maze of data alone. Joint clinical research with internists, who follow postoperative cases, would be highly desirable.

RECOMMENDATIONS

Following a major surgical operation, which prevents oral intake of fluids for a few days, a satisfactory water balance can be maintained with 3000 and not more than 4000 c.c. of fluids. Most of the fluid can be given under the skin, but in the presence of serious complications, the intravenous drip method is useful. Rectally only tap water is given and even that only if no abdominal operation has been performed.

The solution preferred is 5 per cent dextrose under the skin, 10 per cent dextrose intravenously. For the salt balance, 1000 c.c. of Ringer's solution are used under the skin. In certain patients normal salt solution must be given in larger quantities, in others both fluids and salt must be greatly restricted. A senseless, routine, pushing of fluids may lead to conditions which Rowntree so concisely described in the experimental animal: water intoxication.

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ELECTROTHERMIC HEMORRHOIDECTOMY*

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THE high frequency current (surgical diathermy) has become a valuable addition to the surgeon's armamentarium and is now used with success in a wide range of surgical procedures.

Among the conditions particularly suitable for surgery by this method are hemorrhoids. W. L. Clark[2] and others[3,5] have already described methods of procedure and reported series of cases treated either by electrodesiccation or electrocoagulation. The method here presented, electrodesiccation and excision of hemorrhoids by the monopolar high frequency current, is believed to be an improvement and to have many advantages over others in customary use.

Preparation for Operation: A mild cathartic is ordered the night before. If there is chronic constipation, as is usually the case, a sodium bicarbonate enema should be given two hours before operation. If, however, there has been a normal regular movement that morning, no further measures are taken. One hour before operation the patient is given 10 grains of barbital by mouth. This is routine as a prophylactic against the toxic effects of novocaine, following the suggestion of E. G. Martin.* To neurotic patients a preliminary hypodermic of morphine sulphate, gr. ¼ and atropine sulphate, gr. ⅟₁₅₀ is also given.

Anesthesia: Sacral anesthesia is ordinarily used. It is superior to local infiltration because (1) one needle prick only is necessary while local infiltration requires several needle insertions in a very sensitive area; (2) by the former method, the operative field is not distorted and the sphincter ani is not injured.

* *J. A. M. A.,* 91: p. 555, 1928. "Ten grains (0.6 gm.) of soluble barbital by mouth given about one hour before operation will prevent the development of serious toxic symptoms in most instances."

The injection completed and a dressing applied, the patient is immediately placed in the lithotomy position, properly draped, and perineum painted with iodine. This latter procedure is a test for anesthesia because a slight burning is complained of if anesthesia is not complete.

The anal region is inspected for pathological conditions and for relaxation of the sphincter. With the hands on either side of the anus, traction of the skin stretches the sphincter and everts internal hemorrhoids partially. A better view is also obtained of fissures, polyps, ulcers and other pathological conditions which may exist. The lubricated finger is next introduced into the rectum and the sphincter tested for relaxation. The anesthesia, if successful, causes complete relaxation of the sphincter, no movement of contraction is either observed or felt, and no resistance to divulsion is offered (Figs. 1 and 2). Indeed, divulsion becomes unnecessary with successful sacral anesthesia. Palpation further determines the presence of new-growth, polyps, indurated ulcers, etc. A Cook's rectal speculum is next inserted for examination of the rectum under direct vision. If indicated, proctoscopy is done.

Equipment: Any diathermy machine capable of delivering a steady spark ¼ in. long using the Oudin current is suitable. A machine equipped with Leyden jars is preferable because it delivers better and steadier currents for surgical work (endothermy). There is less tendency to char and the spark which is used for the work usually strikes where it is aimed. This latter characteristic is quite important in finer types of work. Bipolar current should not be used. In inexperienced hands, much damage may be done. *The monopolar current is sufficient for the removal of most*

tumors the size of hemorrhoids and is practically foolproof.

Operation: With an Allis clamp, the

have to be applied in the same radial plane as the first and second clamps and traction made outward until the entire

FIG. 1. Successful sacral anesthesia, sphincter relaxed and hemorrhoidal masses bulge outward.

FIG. 2. Completely relaxed sphincter easily divulsed by separating index and middle fingers.
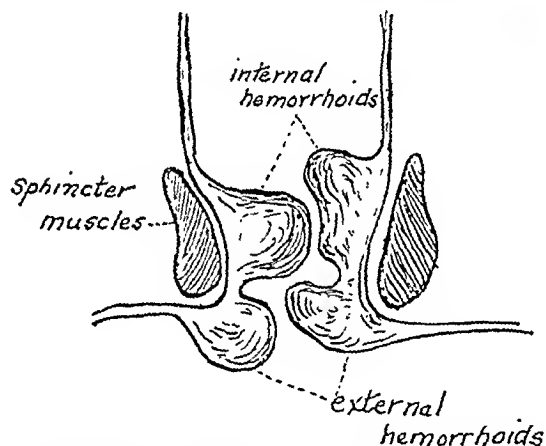
FIG. 3. Diagram in sagittal section of usual arrangement of combined internal and external hemorrhoids.

largest external mass is grasped above the mucocutaneous junction and pulled radially (away from the center of the anal opening). This causes partial or complete eversion of the internal hemorrhoidal mass which is usually found in the same radial plane, with perhaps a slight narrowing at the sphincter, the so-called externo-internal or combined hemorrhoids (Figs. 3 and 4). This internal component is now grasped with a second Allis clamp and drawn in the same direction as the first clamp. If the entire internal mass has not thus been drawn out of the anal canal, a third and even a fourth Allis clamp may
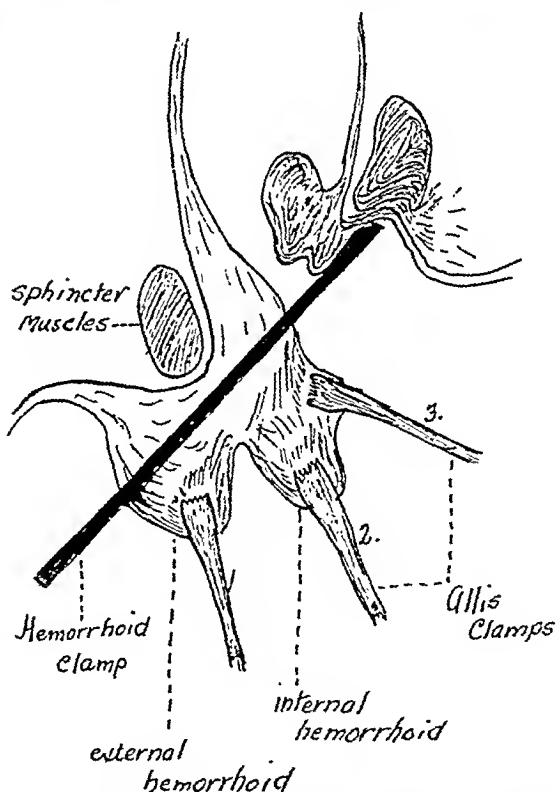
FIG. 4. Application of hemorrhoid clamp (represented by heavy black line) after masses have been pulled downward and outward with Allis clamps, care being taken to avoid the sphincter ani.

mass is exposed. The hemorrhoid clamp is now applied to the base of this combined mass and locked (Fig. 5). The base is

sometimes so long in its long axis as to occupy the entire length of the hemorrhoid clamp. A second hemorrhoid clamp may

FIG. 5. Mass is grasped with Allis clamps and traction made radially. Hemorrhoid clamp applied to the base and locked.

even become necessary. Traction of the Allis clamps should be gently and evenly made; otherwise some of the innermost

A strip of sterile gauze is placed all around the clamp posteriorly, separating the clamp from the underlying anus and surrounding skin. The mass is now ready for electrodesiccation. The Allis clamps are removed and the needle electrode is applied to the mass, the current turned on with the footswitch while an assistant holds the hemorrhoid clamp. The entire outside of the mass is sprayed with the monopolar spark until it becomes gray in appearance. Then the needle is plunged into the mass at regular intervals, thereby desiccating the entire mass in a methodical manner (Fig. 6). Boiling fluid and steam, not smoke, will be seen coming from the tissues. Blood caught in the hemorrhoid will trickle out through the puncture holes made by the needle. The needle acquires from time to time a coat of coagulated blood or tissue, which must be scraped off; otherwise resistance to the transmission of current results in sparking from other parts of the electrode.

When the hemorrhoidal mass is dry, gray and shrunken in appearance (Fig. 7), it is cut off flush with the clamp (Fig. 8).
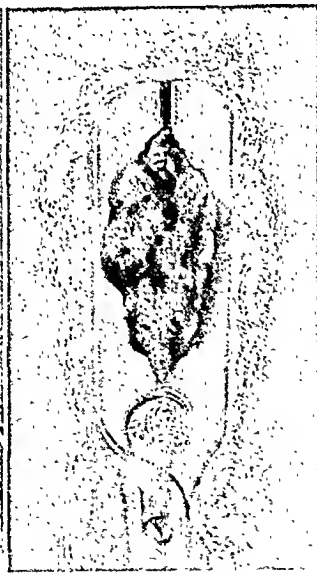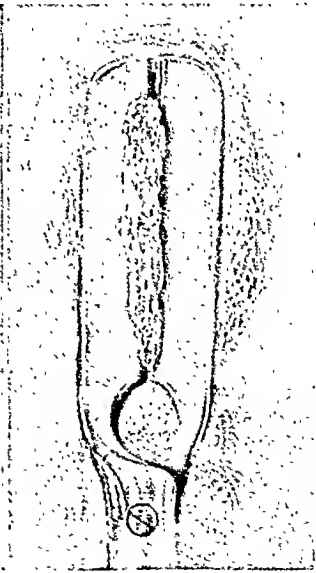
FIG. 6.   FIG. 7.   FIG. 8.   FIG. 9.

FIG. 6. Application of electrode to the hemorrhoidal mass using monopolar current.
FIG. 7. Shrunken appearance after complete desiccation.
FIG. 8. Mass cut off flush with clamp, leaving a desiccated stump.
FIG. 9. Stump of hemorrhoidal mass thoroughly treated with monopolar current until coagulated.

fibers of the sphincter muscles will be caught in the hemorrhoid clamp with resulting postoperative sphincteralgia.

This may be done with the scissors, which is preferable, or with the cutting current of Wyeth (Fig. 6). The stump is now

treated very thoroughly with the monopolar spark (Fig. 9). Not until the stump is thoroughly dry, almost charred, is the

often deliberately separates the wound edges in answer to questions regarding the possibility of hemorrhage from such a
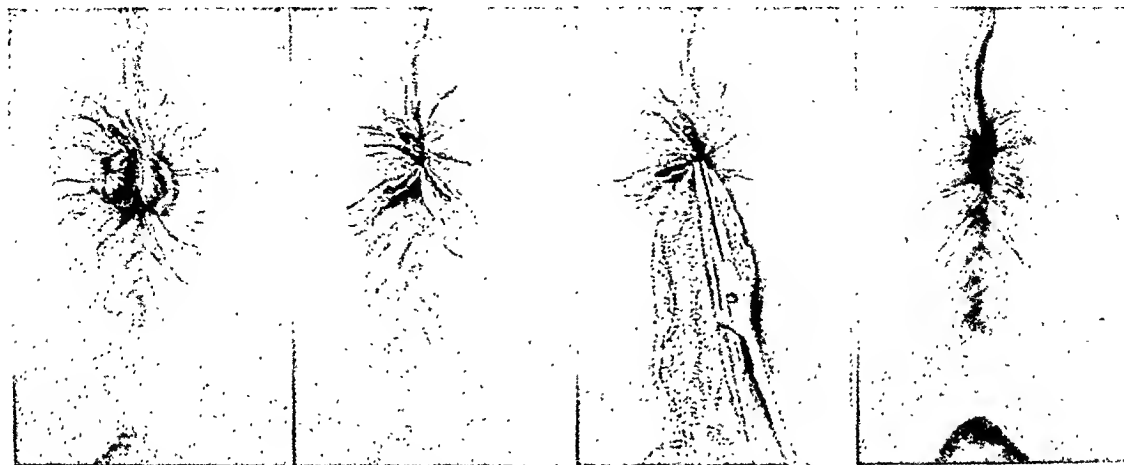
FIG. 10.   FIG. 11.   FIG. 12.   FIG. 13.

FIG. 10. Stump released and allowed to return into the anal canal. Two more hemorrhoidal masses visible. These are treated in a similar manner.

FIG. 11. Operation completed, showing clean, dry stumps of excised hemorrhoidal masses.

FIG. 12. Inserting iodoform gauze impregnated with carbolated vaseline. It is pinned to the perineal dressing which is next applied.

FIG. 13. Appearance two weeks later, wounds entirely healed and covered with new mucous membrane. No scars visible. Operative field soft and piable.

hemorrhoid clamp released, *only one notch at a time*, the stump being further desiccated as it is held between the blades of the clamp. Opening the clamp very slowly enables the operator to detect hemorrhage from poorly treated areas which can be controlled at once. The stump, it is to be remembered, is continuously under traction while in the clamp. Its sudden release causes the greater part of it to retract rapidly into the rectum. A hemorrhage, especially from the innermost ends of the stump, would at this time be most troublesome and should be avoided by the alternate one-notch release of the clamp and desiccation between the blades until it is evident that the stump is dry and clean. Should bleeding occur, it is treated by further desiccation after insertion of a speculum if necessary; or the bleeding point may be grasped with an artery clamp and coagulated. If it is properly performed, however, there should be absolutely no bleeding, even if the wound edges have separated. The author

mishap, but none but some negligible oozing occurs. The stump is then released and allowed to return into the anal canal (Fig. 10). Successively the other masses are similarly treated until all are removed, leaving a clean, dry field. Large and small external and internal hemorrhoids may now be removed reducing the chance of recurrence and preventing the formation of new hemorrhoids from small masses which at the time of operation by other methods are either overlooked or invisible because of the bloody field (Fig. 11).

Finally a small strip of iodoform gauze liberally impregnated with carbolated vaseline is inserted in the rectum (Fig. 12), the external end of which is pinned to several squares of gauze pressed against the anus. A thick pad followed by a T-binder is now tightly applied to the perineum.

The duration of the operation, depending upon the number of masses to be removed, is from fifteen to thirty minutes, occasionally longer. Toward the end of a long operation, most often after the

operation has been completed, a patient may complain of burning which may be slight, moderate or severe, indicating a return of sensation. This burning sensation is of short duration, rarely lasting for more than a half-hour and is quickly controlled by a hot water bag or an electric pad applied to the perineum as soon as the patient arrives home. If the immediate postoperative burning is severe, a hypodermic injection of morphine with atropine is given.

Postoperative Care and Course: The patient is kept in bed for two days but is allowed bathroom privileges. Normally, patients pass through a very comfortable postoperative period and in most instances are able to return to work or carry on their usual activities after the fourth day without the aid of any sedatives whatever.

Examination of the wound next day will reveal a remarkable absence of reactive inflammation. So little have the tissues been damaged that edema, swelling, tenderness or other evidences of operative trauma are rarely present. One can usually press his hand directly against the wounds without causing any pain. Occasionally one or more stumps will be found slightly inflamed or tender; but ordinarily no reactive inflammation should be found during the postoperative course, even when the patient, prior to operation, has had edematous, inflamed hemorrhoids.

Any time after the second day the coagulated stumps begin to slough slightly and separate from the underlying granulating base. From this time until complete healing takes place, about two weeks, there may be a few drops of blood in the stool, or the stool may be blood-streaked. The stool as it passes over the granulating wounds causes some bleeding usually negligible. It stops after the bowel movement and may not be noticed. *In over 200 cases there has never been a secondary hemorrhage and it is never to be feared if this technique is carried out in detail.* Approximately two weeks after operation the wounds are healed and covered with

new mucous membrane. Scars are not visible and it is difficult to locate without careful search the sites of the excised
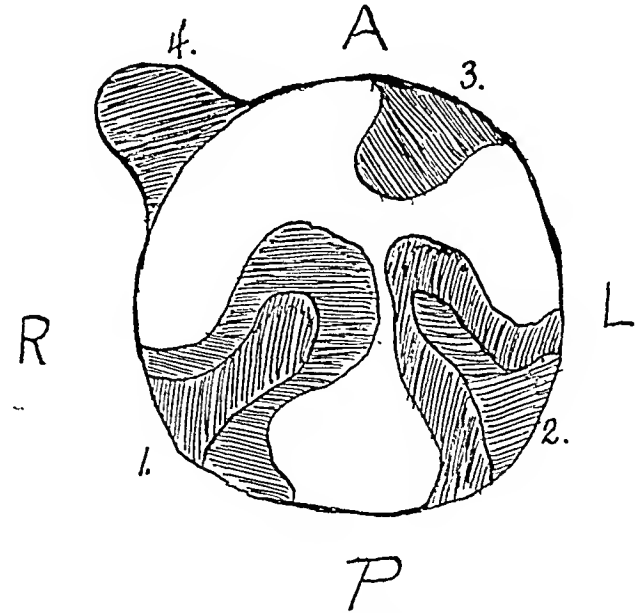
FIG. 14. Diagrammatic representation of location, type and extent of anal pathology, for use on patient's history sheets. R, right, L, left, P, posterior, A, anterior; 1 and 2, combined internal and external hemorrhoids; 3, internal; 4, external hemorrhoids.

hemorrhoids. The operative field is soft and pliable (Fig. 13).

A simple diagram is made on the patient's chart, showing the approximate locations and size of the hemorrhoids removed (Fig. 14). This chart has assisted materially in subsequent follow-up examinations. Should a patient return with more hemorrhoids, reference to the diagram indicates whether or not the mass or masses recurred in the operated area or have formed anew in areas not operated upon. The patient is not discharged until healing is complete and he is followed for one year subsequent to operation.

Diet and Catharsis: The patient is given a non-constipating diet upon leaving the office. After the second day one tablespoonful of an agar-oil mixture may be taken at night if necessary. After each bowel movement the anal region is gently washed with a sponge and warm, soapy water and carbolated vaseline is applied on gauze. It is desirable not to have a bowel movement until the third morning, thereby

permitting the operative area to rest. On the second postoperative day the iodoform gauze packing is removed. (The patient may have a natural bowel movement on the second day, passing the gauze spontaneously.) Usually, however, a dose of agar-oil mixture is necessary to initiate a bowel movement the next morning, and thereafter daily morning movements, usually painless, are to be encouraged. More than one movement results in tenesmus as the sphincter becomes too active and causes rectal pain in contracting. Cathartics or oil should then be discontinued. Tenesmus after bowel movement is controlled by heat (electric pad, hot water bag or hot Sitz bath). Rarely are sedatives required.

Insistance upon a non-constipating diet has been beneficial not only in assisting the cure of constipation but also in preventing recurrence of the hemorrhoidal condition.

SUMMARY

Over 200 cases have been operated upon in this manner. Compared with other methods, the following advantages are claimed for it:

1. Under suitable circumstances, it may be done in the office.

2. There is no blood loss.

3. No complications such as fissures, ulcers, infections, abscesses, strictures, or loss of sphincter control have occurred.

4. No recurrences have been observed after this method was used during the past four years.

5. Convalescence is shorter and more comfortable. Total disability rarely exceeds four days.

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HALLUX VALGUS[*]

ITS CAUSE AND SIMPLIFIED TREATMENT

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THE purpose of this article is to show:
1. That hallux valgus is not an enlarged joint;

is the spring arch. In walking, the streams of weight-bearing (or moving load) travel through the foot in an *orderly manner*,
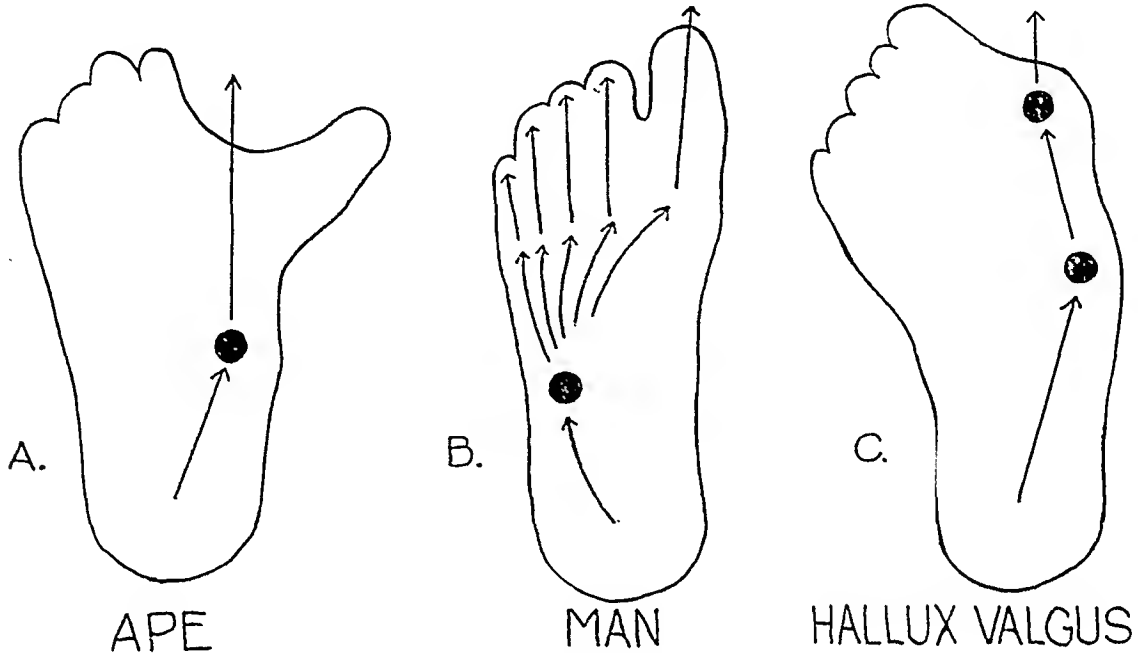
FIG. 1. A, ape; B, man; C, hallux valgus.

2. That broken arches and hallux valgus are the result of the same forces working on the foot;

3. That there is a phylogenetic set-up for hallux valgus;

4. That hallux valgus is the result of tendon imbalance across the great toe joint;

5. That hallux valgus can be corrected without removing the head of great metatarsal bone.

ANATOMY

For brevity's sake, only the anatomy of the longitudinal arches will be mentioned. The outer one, composed of cuboid bone, and fourth and fifth metatarsals, is the main weight-bearing arch. The inner one, composed of scaphoid, cuneiforms, and first, second and third metatarsals,

from the heel to the outer side of the foot, across the ball and through the toes (see Fig. 1, B).

HALLUX VALGUS AND BROKEN ARCHES

Improperly proportioned shoes produce a disorderly irregularity of the distribution of the moving load. Figure 2 shows a foot imprint in relation to the insole pattern of an ordinary shoe. Point A is a fixed point ahead of the great toe joint caused by the cap or boxing; point B is a fixed point produced by the counter; and point C is a pressure point because shoes do not have enough room in them at this point, due to the failure of last makers to put enough wood in the last. Point C, working against points A and B, insidiously molds the foot out of line or in a position of eversion. I believe it is commonly accepted

that eversion is an early step that produces unbalanced foot action and broken arches. This will disturb the distribution of the

FIG. 2. Foot imprint in relation to insole pattern of ordinary shoe.

moving load, resulting in foot strain because the weight-bearing will move mesially on to the spring arch (see Fig. 1, c.)

This vicious action of shoes not only throws too much weight on the great toe joint, but produces a mesially directed force, shown by the long arrow in Figure 2, which pushes the head of great metatarsal bone inward and off the foundation which is made up of sesamoid bones, muscle and fascia.

In the writer's series of 1812 cases comprising 3092 bunions, 60.3 per cent had everted feet, 32.4 per cent had drop of spring arch, and 82.1 per cent had malposition of arch bones.

CAUSE OF HALLUX VALGUS

The phylogenetic development and the human anatomy of the great toe joint reveal the fact that there is nothing to resist this mesial thrust caused by shoes. Figure 4, A shows the structures below

the great toe joint. *Note that all of the muscles are attached to the phalanges, distal to the metatarsal head.* Figure 3 shows the abductor hallucis and adductor hallucis in the monkey (macaque) A, chimpanzee B, ape C and man D. The macaque's foot has a strong adductor with which to firmly grasp a limb, the only function of the abductor being to pull the great toe outward for the next strong grasp. The chimpanzee spends most of the time in the trees and part of the time on the ground, the ape spends most of the time on the ground, and man all of the time on the ground. Note the gradual change of structure of the skeleton, with the retention of the same adductors and abductors. *But remember the adductor is by far the stronger muscle.* The black dots on these skeletons show the weight-bearing focus which is at the internal cuneiform bone in our progenitors (see side view of ape Fig. 3, E) as they do not have an arch. In this evolutionary development, suddenly an arch develops in man and the weight-bearing is focused at cuboid bone (see Fig. 1, B, and Fig. 3, D and F.)

Shoes evert the foot and throw the weight-bearing mesially, which is a *retrogression to primitive type walking*, although most cases maintain the arch thereby throwing the extra load on the great toe joint (see Fig. 1, c and compare it with Fig. 1, A). Shoes also destroy the function of great toe abduction; that is: no one who wears shoes can separate the great toe from the second toe as we pull the thumb away from the index finger. Newborn babes can do it and so can barefoot natives of South Africa. It is a well known fact in treatment of deformities that when one muscle loses its function through paralysis, the antagonistic muscle will pull the joint into a deformed position. Pulling across the great toe joint we have a strong adductor, and a weak abductor that has lost its function through the disturbing action of shoes. On top of this we have a mesial thrust from shoes which pushes the great toe joint inward. Figure 4, B

shows the result. The adductor pulls the great toe outward through its attachment to the proximal phalanx; the useless

FIG. 3. Abductor hallucis and adductor hallucis, A, monkey (macaque); B, chimpanzee; C, ape; D, man; E, side view of ape; F, arch in man.

abductor tendon slides under the joint; and the great toe joint buckles over the top and mesially. The flexor brevis hallucis, whose double tendons contain the sesamoids, plays a secondary rôle, but pulls the outer sesamoid between the first and second toes. *Therefore hallux valgus is primarily a buckle joint and not an enlarged joint, the osteophytic outgrowth on the great metatarsal head and the inflamed bursa or bunion being secondary to irritation from shoe pressure, as the joint buckles with every step.*

To sum up, hallux valgus is the result of:

1. Phylogenetically developed stronger adduction than abduction;

2. Tendon imbalance from lost abduction;

3. Joint buckling from mesial thrust of shoes; and

4. Excess weight-bearing from eversion of whole foot.

VARIOUS BUNION OPERATIONS

With these causative factors in mind,

it is easy to judge the efficacy of the various bunion operations.

The Heuter-Mayo method of amputation of the head of the great metatarsal and interposition of a flap, needs only be mentioned to be condemned. It not only fails to correct the tendon imbalance, but destroys the most important weight-bearing point in the front of the foot. The procedure is so radical that the foot may never readjust to the abnormal change. Fuel is often added to the flame by thus removing a weight-bearing point that is already carrying too much load, thereby causing increased foot strain.

The Keller method of removing the mesial half of the head of the great metatarsal is not quite so radical, but it does not correct the tendon imbalance and thereby does not relieve the buckling. However, those cases of patients unsuccessfully operated by this method can still be corrected by the overcoming of tendon imbalance.

The removal of a wedge of bone (cuneiform osteotomy) from inner side of meta-

tarsal head as well as cutting the outer ligaments of the joint capsule and overlapping the inner ligaments (Silver's method)

attention to tendon imbalance, I cannot accept his theory. The removal of both sesamoids to cure hallux valgus does not
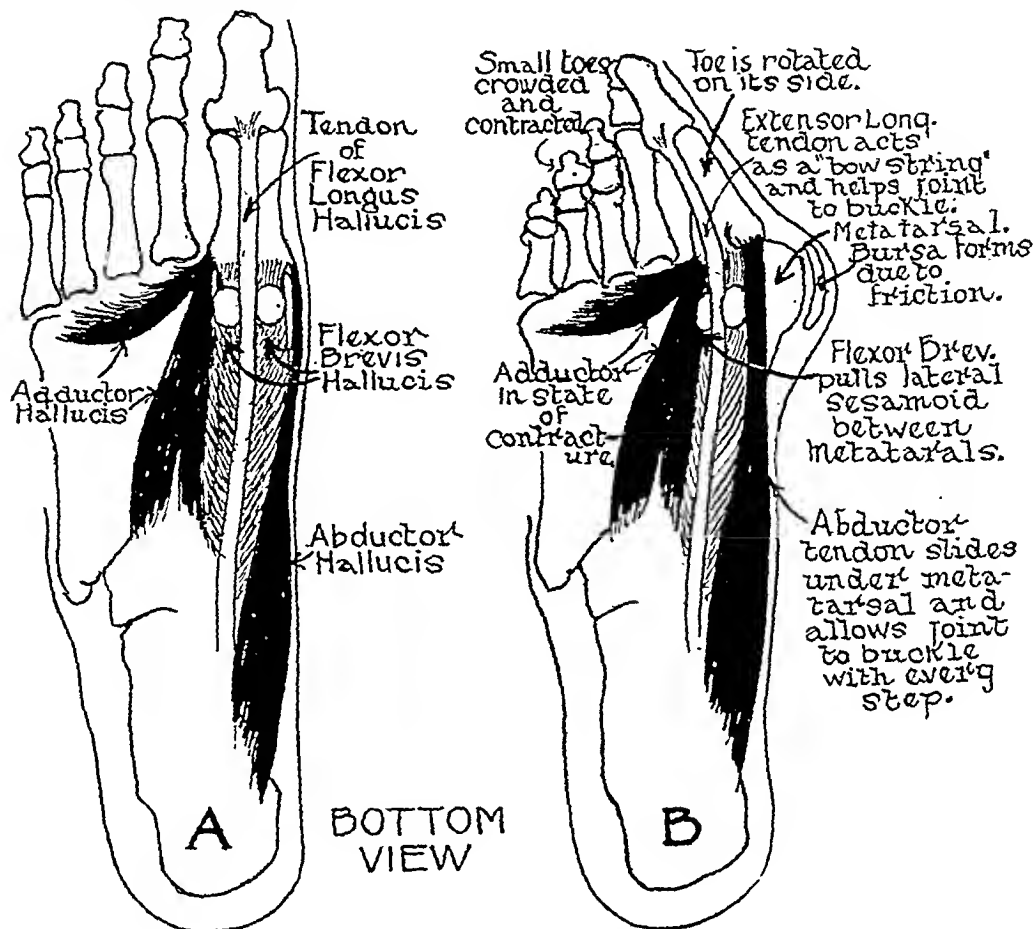
FIG. 4. A, Structures below great toe joint. B, mesial thrust from shoes which pushes great toe joint inward.

are theoretically unsound, as tendon imbalance and buckling still persist.

In 1911 Dr. Curtis Brigham removed sesamoids for hallux valgus, but later dropped the procedure. Since 1915 Dr. H. W. Robinson has been removing sesamoids also, and claims that all bunions are hereditary and that shoes never caused a bunion. The fact that hallux valgus is comparatively rare in men who wear sensible shoes, not only refutes the hereditary idea, but augments the argument that shoes are the immediate cause. His theory also claims that sesamoids push the head of great metatarsal mesially. In view of the facts brought out that sesamoids are only a secondary factor and that he pays no

correct tendon imbalance, but is likely to produce an upward buckling of the great toe, because complete severing of both flexor brevis hallucis tendons is unavoidable (as sesamoids are imbedded therein), leaving the extensor brevis free to pull the proximal phalanx upward. In other words a dorsoplantar tendon imbalance may be produced, which is as painful as hallux valgus. Removal of both sesamoids leaves the flexor longus hallucis tendon unprotected, so this tendon flattens out and becomes adherent in the connective tissue mass in the deep fascia resulting from surgical trauma. Even though this procedure is unphysiological, it does not

destroy a weight-bearing point, and may reduce the severity of the buckling, although tendon imbalance still exists.

Fig. 5. Before and after operation by base correction method.

AUTHOR'S METHOD

The method devised by the writer, which he terms the Base Correction Method, has for its purpose:

1. To correct tendon imbalance;
2. To overcome joint buckling;
3. To strengthen phylogenetic weakness;
4. To place the metatarsal head on its base; and
5. To relieve excess load on the great toe joint.

In the first place there is no set orthodox technique that will meet the various complex situations met in the many varieties of bunions.

Arch treatment will aid in the proper distribution of the moving load and the writer prefers to do this by manipulation. This relieves the excess weight on the great toe joint.

To correct tendon imbalance adductor tenotomy is always done. Transplanting of the abductor tendon is done, without tenotomy, pulling it up to the normal mesial position and suturing it to the periosteum of the great metatarsal bone. The mesial side of metatarsal head is denuded, thereby removing the osteophytic bone, and furnishing a bed for the re-location of the abductor tendon. Here we take advantage of the postoperative joint infiltration, which firmly anchors abductor to joint capsule and bone by a firm fibrous mass. This also overcomes the phylogenetic and shoe-acquired abductor weakness, and restores joint action without buckling.

In order to produce this restoration of tendon balance, other secondary procedures will have to be restored to according to the conditions presented by the type of case at hand. Intermetatarsal resistance, produced by tissue changes from the chronic nature of the deformity, must be overcome. So lateral capsulotomy may be necessary. Often interphalangeal

fasciotomy and skin lengthening are done. The malposition of the outer portion of the flexor brevis hallucis may require

function; and (2) a deep appreciation of pressure points in shoes. The writer constantly checks joint function in making a
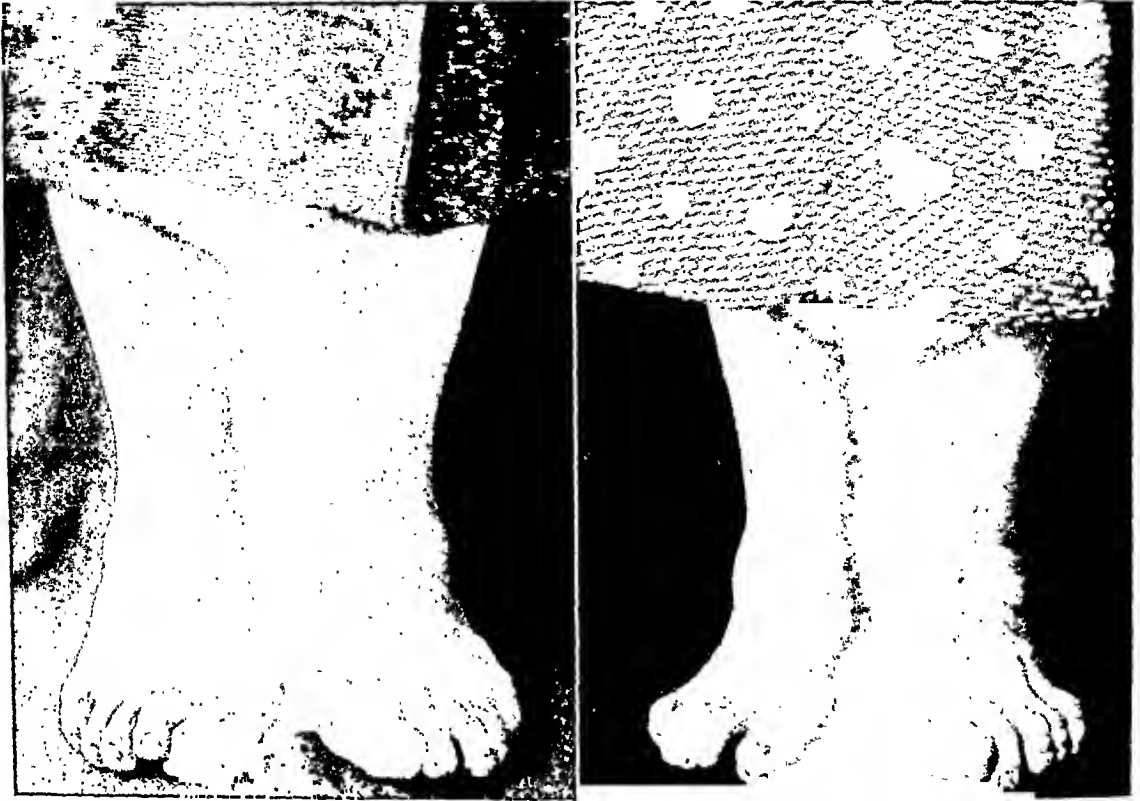
FIG. 6. Before and after operation by base correction method. This patient walked four miles, three weeks after her operation.

tenotomy or lateral sesamoidectomy. Extensor brevis hallucis tenotomy may help, due to the angular pull of this muscle.

Restoration of joint alignment may be prohibited by an obstructing joint lipping on the mesial side of distal end of great metatarsal, which must be removed with the other osteophytic bone.

The closure involves mesial elliptical capsulectomy which not only removes the proliferating cartilage, but takes up capsular slack and strengthens the position of the imbedded abductor hallucis tendon. Skin closure involves elliptical removal of excess skin which not only removes the subcutaneous bursa (the bunion), but the painful callus also.

The writer has often said that foot surgery involves two main thoughts: (1) A thorough understanding of complex foot

choice of the combination of procedures to be used in an operation, and is always looking for bony prominences that may later cause shoe pressure. In closing this operation, he always looks for exostoses on the mesial wing of the base of proximal phalanx, on the superomesial aspect of the head of great metatarsal, and on the base of the sesamoid bones. If present they must be removed.

The work is all done under local conduction anesthesia, using a 1 per cent procaine solution. When tendon balance is properly restored the great toe will stand up in perfect alignment, without support, and the patient can flex and extend the toe before leaving operation room. Therefore no splints or casts are used. A soft surgical dressing is loosely applied, and a loose,

gauze-covered cotton pad is placed between first and second toes.

Stitches are removed in ten days and the patient is allowed to walk on the twelfth day. The feet are placed in shoes as narrow as we can get them into. The convalescent period is very short because normal function has been restored and no weight-bearing points removed. Figure 5 shows a case before and after operation by the Base Correction method. Dotted lines show the restored balance in tendons. The head of the metatarsal has not been removed.

CONCLUSIONS

1. Hallux valgus is not an enlarged joint;

2. Hallux valgus is primarily tendon imbalance and joint buckling;

3. Phylogenesis plays an important predisposing rôle;

4. Shoes are the immediate cause of hallux valgus;

5. Broken arches and hallux valgus are the result of the same vicious forces;

6. Excess weight-bearing on the great toe joint can be relieved by treatment to the arches;

7. Surgery involves restoration of tendon balances, rather than destruction of weight-bearing points;

8. No set orthodox technique will cope with all varieties of hallux valgus.
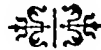
MECHANICAL DRAINAGE IN SURGICAL UROLOGY*

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NEW YORK

DRAINAGE of the preoperative and postoperative cases has always been an important phase of surgical
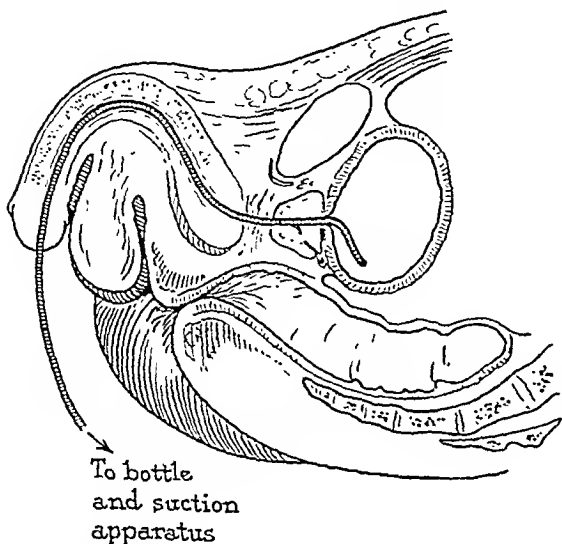
FIG. 1. Mechanical suction applied to indwelling catheter is extremely useful in preliminary stages of drainage if prostate is of type that bleeds easily, as a little gentle suction prevents clot formation, in the majority of cases.

urology. This problem has been met in several ways, and the mechanical appliances that have been devised to handle it are numerous. Drainage of these cases requires, first, a classification as to the nature of the lesion, and secondly, a consideration of the mechanical environment under which the drainage must be carried on.

Since the opening of the Squier Urological Clinic almost three years ago, there has been a constant stream of inquiries, written and verbal, from our many visitors and friends in this country and abroad, as to how the drainage problem is handled.

Prior to the opening of the Clinic, a variety of methods and apparatus had been tried, and many failures and changes marked the five years of experimentation which preceded the installation and adoption of the present system. Three more years elapsed before it was felt that the knowledge gained was of sufficient value to be given to our colleagues.

The apparatus and methods now in use have stood the test of time and of everyday use in a large group of rapidly changing cases. Improvements will be made, and there is a constant effort to make them; but the aim throughout has been to make use of the simplest apparatus and simplest forces available to produce the desired results. The force found to be best is gravity, and the substances used are water and air. Where necessary, though not as satisfactory, electricity is used. How the problem is handled will be shown in detail by drawings, photographs, and descriptions.

THE SUPRAPUBIC GROUP

ONE-STAGE PROSTATECTOMIES, CYSTOTOMIES, BLADDER RESECTIONS. Prostatectomies make up the bulk of this group. Preoperative drainage is carried on in these cases by the use of indwelling urethral catheters, a tube leading from the catheter to a bottle hung in a sling on the side of the bed is the most satisfactory. The catheter is held in the urethra by adhesive tape and connected to the rubber tube leading to the bottle by means of a simple connecting tip. If the patient is ambulatory he may carry the bottle with him and place it in any position beside his chair. This is the simple case, and requires no aid to the force of gravity.

The infected case or one in which the prostate bleeds easily, forming clots in the bladder, is better handled if a slight suction is kept constantly in effect through the catheter. The suction must be just sufficient to keep the bladder empty and clean but not to collapse the catheter or draw the bladder wall into the eyelets of the

Rotary suction pump
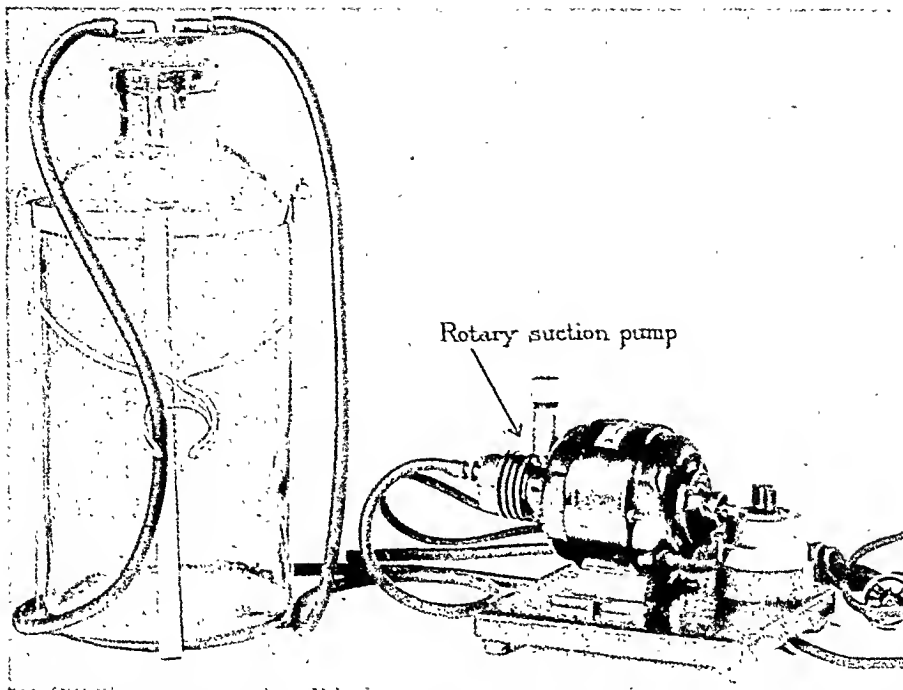
FIG. 2. Small alternating or direct current motor with rotary pump attached to motor shaft. A switch and rheostat are mounted in the base on which the motor stands. The weight of the motor, rheostat and switch is only 8 lb., and it occupies about 1 cu. ft. Bottle and sling are shown.

FIG. 3. Bedside application of electric suction apparatus. It is practically noiseless and the patient soon becomes used to slight continuous hum of motor.
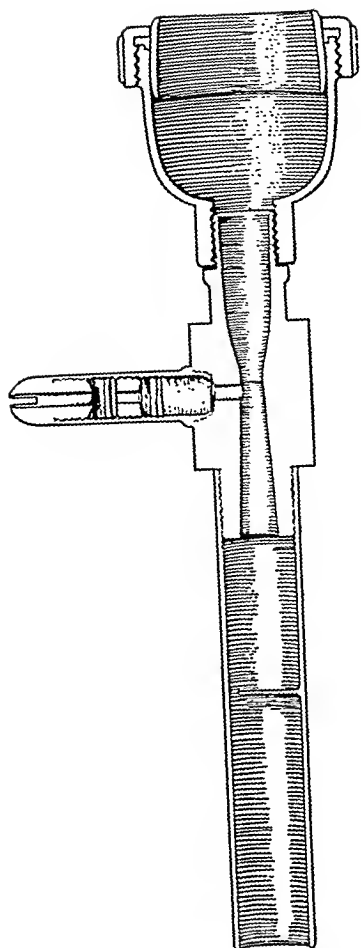
FIG. 4. Cross section of Chapman suction pump to show simplicity of mechanism. There are no moving parts to get out of order.
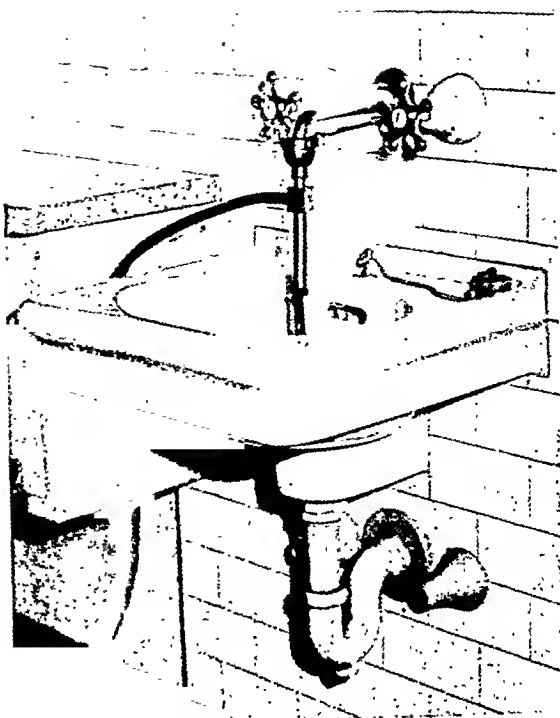
FIG. 5. Simple water suction pump attached in ordinary wash basin with rubber tube leading to patient's bed and larger rubber tube attached to outlet to prevent any noise or splashing. Whenever it is necessary to use the tap, this latter is easily removed.
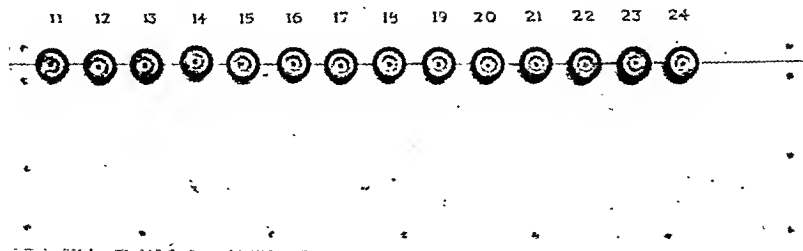
FIG. 6. Numbered hand controls corresponding to number on taps at beds. The suction pumps themselves are covered by plates, as shown, flush with the wall.

catheter (Fig. 1). How this suction may be generated depends entirely upon the mechanical environment of the patient; that

rooms and wards, a small motor operating on alternating or direct current and having a centrifugal pump mounted on its shaft
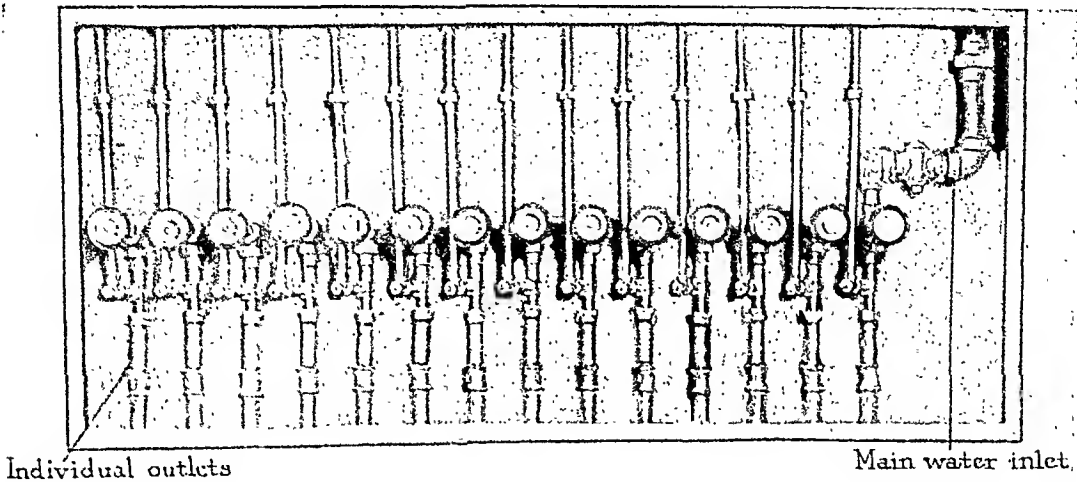
Fig. 7. Central suction station with a series of suction pumps placed in wall at central point.

is, whether or not there is running water available in his vicinity, whether there is available electric current, or whether

and a rheostat under its base to regulate the speed and hence the amount of suction, has proved efficient; but it is inferior to the
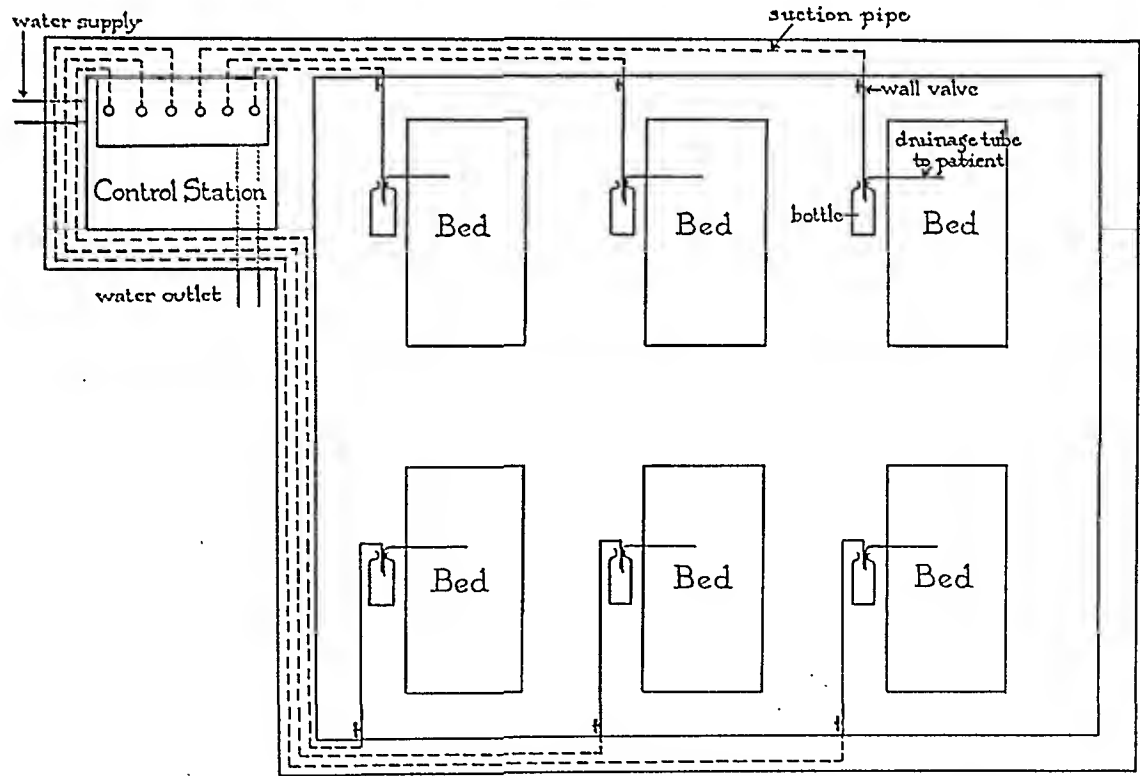
Fig. 8. Floor plan showing how water apparatus used in individual cases has been employed for large groups of cases by installing a series of suction pumps at a single point and piping to individual taps in the wall at the head of each bed.

there is an automatic drainage system, such as is installed in the wards of this Clinic.

Where electricity but not running water is available, as is the case in many hospital

simple water suction pumps, which have been found, after several years of experimentation with all types of apparatus, to be the most satisfactory (Figs. 2, 3).
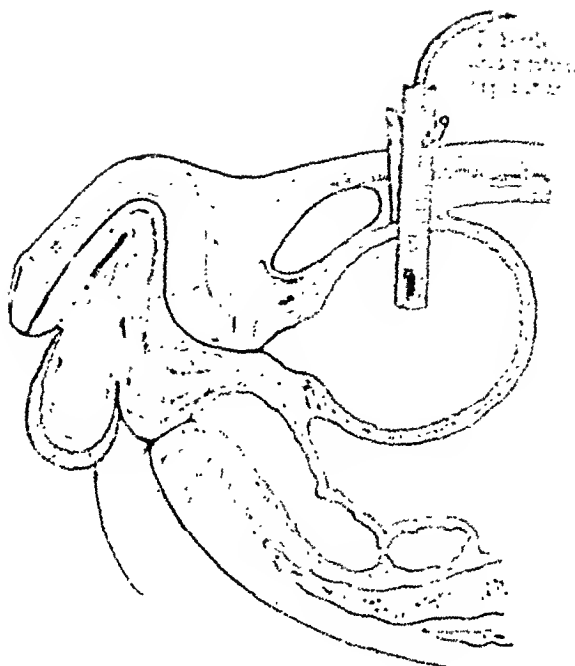
FIG. 9. Arrangement of Freyer tube and suction catheter immediately after operation, at which time suction is started. The cigarette drain is removed twenty-four hours after operation, and the tube and catheter on the fourth postoperative day; in cases of bladder resection on the seventh postoperative day.

FIG. 10. Patient immediately after operation, the Freyer tube fastened in suprapubic wound, a catheter inserted in the Freyer tube, its tip just above the eyelets of the larger tube and held in place by a safety pin which is put through the walls of the Freyer tube only. Distal end of catheter is shown connected to rubber tube leading to drainage bottle. This connection is made with ordinary glass connection tip.
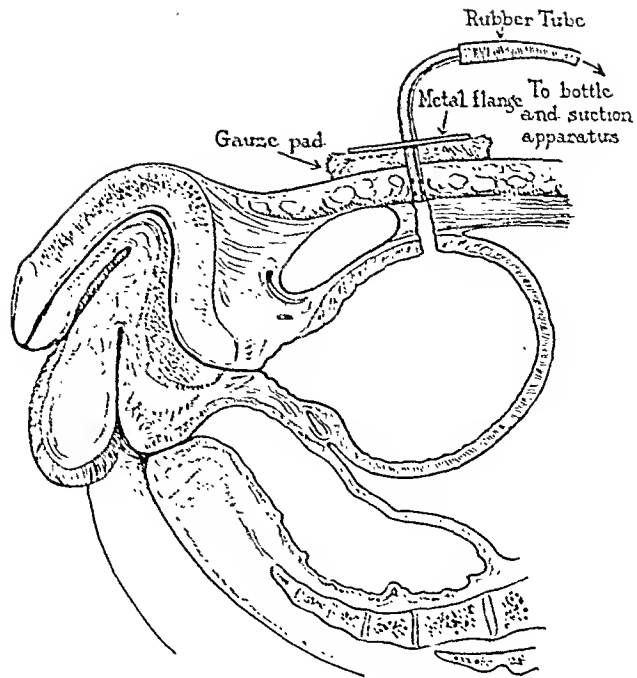
FIG. 11. Arrangement of suction apparatus after removal of drain (Freyer tube and catheter). Here is shown the Gile suction apparatus with a small gauze pad under the flange and the tip of the sucker no deeper than the skin level.
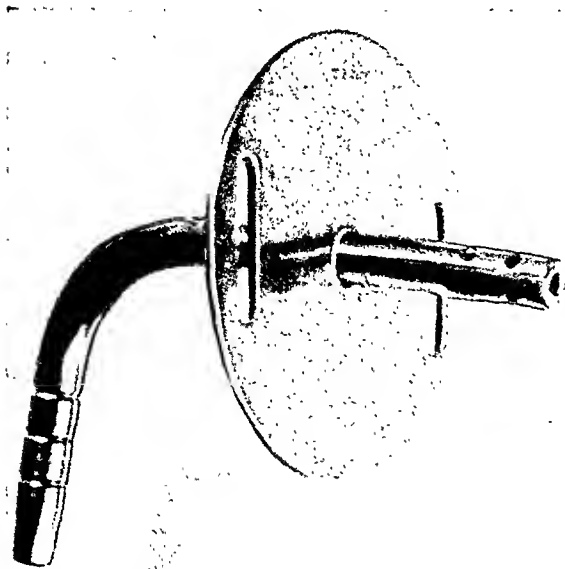
FIG. 12. Gile metal suprapubic suction apparatus. (For detailed description see *Surg., Gynec. Obst.*, 42: 713, 1926.)
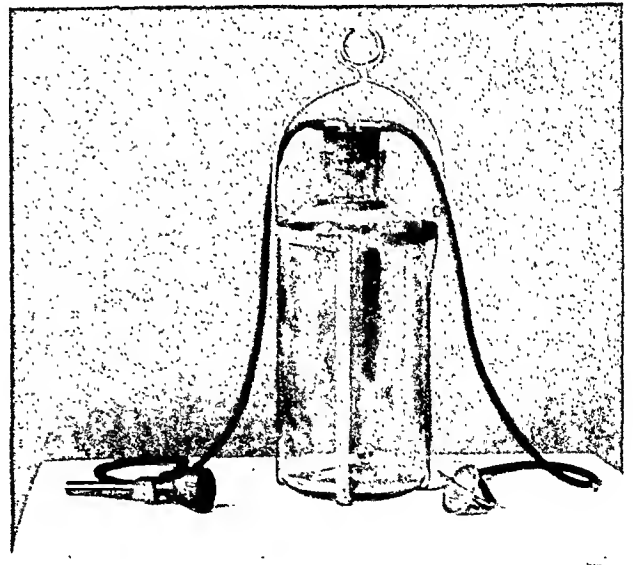
FIG. 13. Complete water suction apparatus, suction pump attached to faucet, bottle, metal sling for hanging on bed, and Gile suction apparatus.
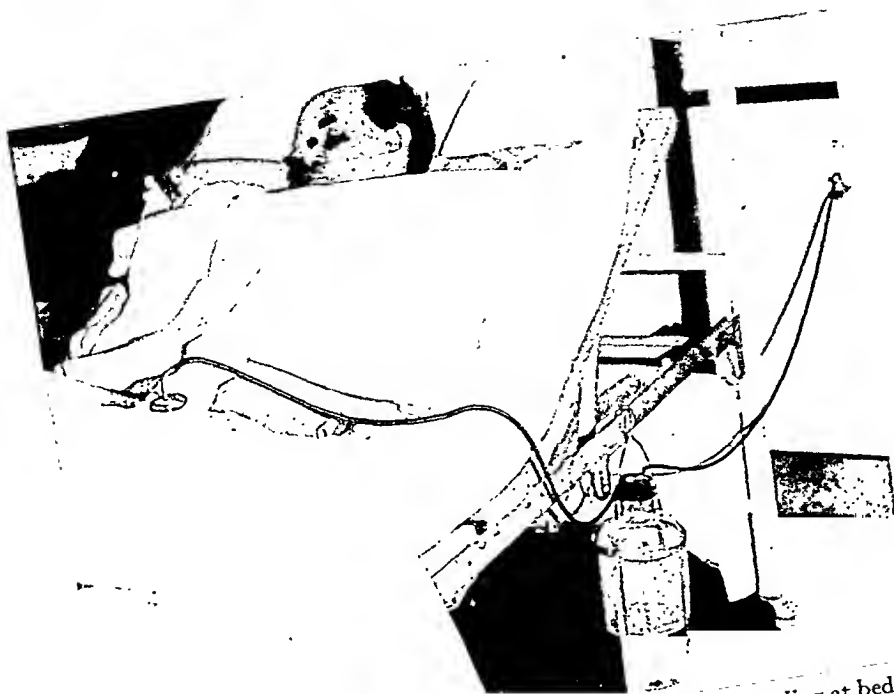
FIG. 14. Patient with Gile suction apparatus in prostatectomy wound, bottle in sling at bedside, and rubber connection leading to wall tap which is connected to central station in control room.
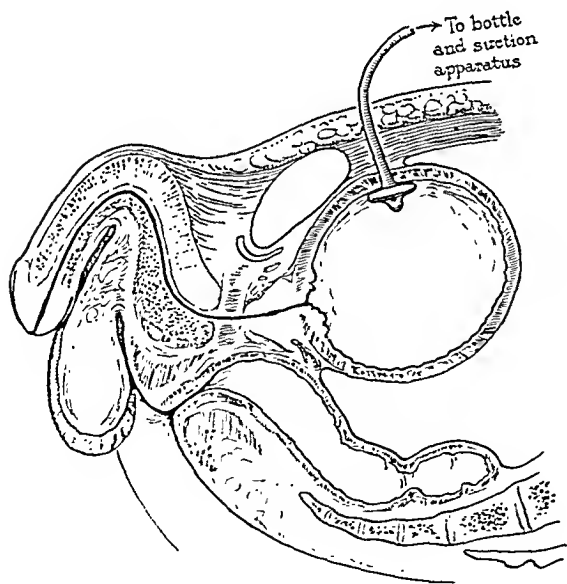
FIG. 15. Suction applied to mushroom catheter whether it be in a two-stage prostatectomy, in the simple cystotomy for malignancy, or in the terminal bedridden malignant case, insures a drier and more comfortable patient.
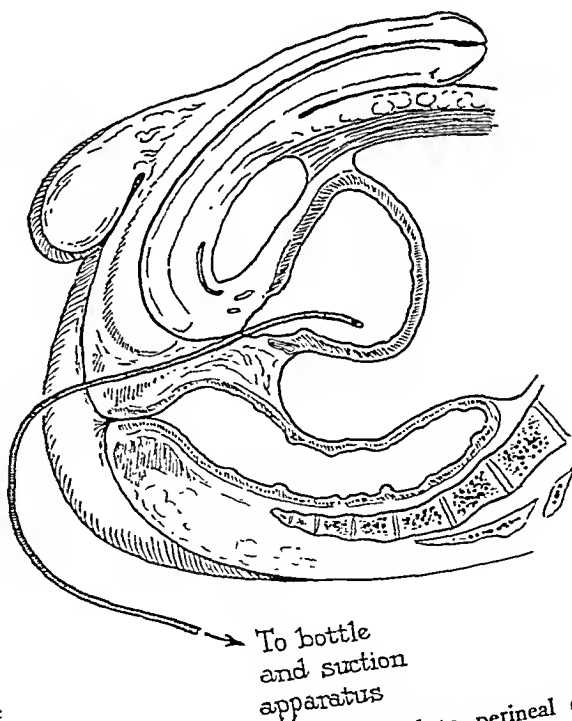
FIG. 16. Suction properly applied to perineal case whether drainage be through perineum or urethra insures a drier cleaner wound, takes care of any small clots, and saves dressings.

A simple Chapman suction pump is used and the amount of suction regulated by increasing or decreasing the amount of flow of water through the apparatus (Figs. 4, 5). If the water faucet is close to the patient's bed, the constant noise of the running water may be annoying, but this can easily be eliminated by attaching a short piece of rubber tubing to the pump and inserting it in the waste pipe below.

This type of apparatus is used on all cases occupying single rooms, and a multiple application of the same principle is used for the larger group of cases in the wards by installing a series of pumps at a central point and piping through the walls to individual spigots at each bed (Figs. 6, 7, 8).

Suction drainage is commenced on the one-stage suprapubic cases as soon as the patients are returned to bed from the operating room. A soft rubber catheter is inserted into the Freyer suprapubic tube and held by a safety pin placed through the tube but not through the catheter (Figs. 9, 10). The catheter is then connected with the suction pump by a glass connecting tip and rubber tube. This immediate application of suction does not increase any bleeding that may be present but tends to stop clot formation in the Freyer tube and insures a clean dry wound from the beginning. When the Freyer tube is removed, usually on the fourth day, a Gile metal suction disc is placed over the suprapubic wound, the suction tip extending just below the skin level, and drainage kept up through this as long as the sinus drains; i.e., until the patient begins to void (Figs. 11, 12, 13, 14). A suction apparatus of this kind does not slow up the healing of the wounds, as the suction chamber penetrates through the skin only. Large series of cases have been operated with and without the use of the postoperative suction, and the average time of healing has been found to be the same, the great difference in the two groups being that in the non-suction group the patient has been wet and miserable, and in the

suction group, dry and comfortable, to say nothing of a very considerable saving of dressings, linen and nursing care.
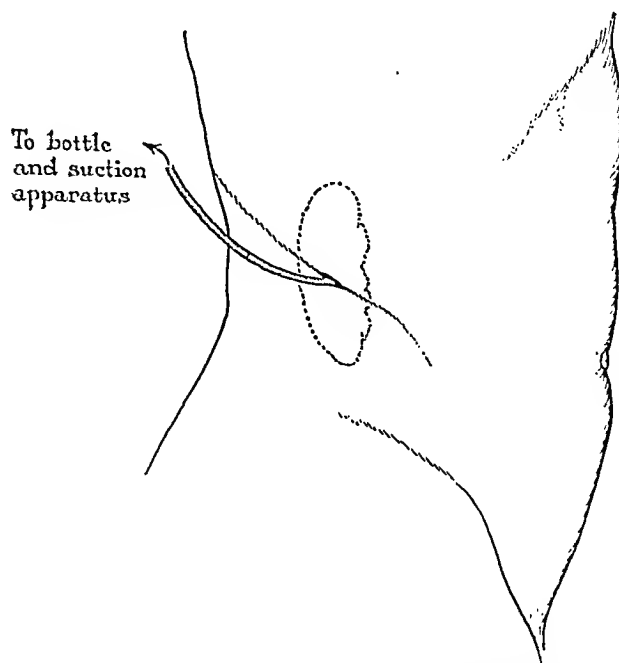
Fig. 17. Where it is desirable to keep kidney wounds open and where large amounts of urine or thin pus are discharging, mechanical drainage is very satisfactory.

BLADDER RESECTION CASES. The bladder resection cases are handled, as far as the drainage is concerned, in exactly the same way as the one-stage prostatectomies. Drainage is started immediately after operation, but the smaller suprapubic rubber drainage tube is left in the suprapubic wound until the seventh or eighth day, at which time suction through the Gile apparatus is started.

THE TWO-STAGE GROUP

This group of patients is divided into three classes: First, where the patient's condition is so poor, the kidneys and bladder so badly infected, that a two-stage operation is indicated. Such a case is drained by putting a Freyer tube into the bladder through a cystotomy wound and arranging the suction for four or five days as in the first group. After a preliminary period, a large mushroom catheter is inserted and suction kept up until the second operation seems advisable (Fig. 15).

In the second class of cases are the pa-

tients who have had a preliminary suprapubic operation done elsewhere and in whom a sinus is already present. Either a Gile suction apparatus or a mushroom catheter works quite satisfactorily with these.

PERINEAL WOUNDS. The perineal cases are drained preoperatively, as are the suprapubic ones, that is, through the sinus made by nature, the urethra. Postoperatively, the suction apparatus is applied to the perineal tube and the patient kept dry and his bed clean until the perineal tube is removed. If a urethral catheter has been inserted at the time of operation, gentle suction applied through it results in a cleaner and drier perineal wound (Fig. 16).

DRAINAGE OF PYONEPHROTIC AND HYDRONEPHROTIC KIDNEYS

Removal of such lesions is of course preferable in one operation, but when the condition of the patient is such as to make preliminary drainage necessary, suction applied after the insertion of the drainage tube has been found to result in a drier, more comfortable patient and a cleaner wound (Fig. 17).

SUMMARY

Mechanical suction applied to wounds draining urine results in:

1. Cleaner wounds, more comfortable patients, less nursing care and a tremendous saving of expenditure for dressings and laundry.

2. Mechanical difficulties are practically non-existent when water suction is used.

3. Water suction, where it is available, is the cheapest from the standpoint of power and apparatus, and is the most highly satisfactory.

4. Suction by means of electrically driven rotary pumps is next in simplicity and results, though considerably more expensive and subject to more mechanical hazards.

5. The various types of gravity apparatus have been found, in this clinic, to be cumbersome and unsatisfactory.

6. There is no delay in healing when suction is applied, often an increase because of cleaner wounds.

CONGENITAL HYPERTROPHIC URETEROPELVIC OBSTRUCTION*

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CHARLOTTE, N. C.

IT is quite natural to designate those conditions as congenital which appear in the early years of life and whose underlying pathology is obscure.

Hydronephrosis resulting from true congenital obstruction of the ureteropelvic junction is exceedingly rare. Although a number of such cases are reported, the etiology is usually found to be, upon close scrutiny, not congenital in origin but the end-result of an infection in the wall of the ureter.

Since hydronephrosis is caused by mechanical obstruction to the outflow of urine from the pelvis of the kidney, ureteral blockage from any cause will produce it. The more frequent causes of this obstruction are:

A. *Aberrant Vessels:* The recent literature has been filled with descriptions and pyelograms of hydronephrosis caused by aberrant vessels passing across the ureteropelvic junction and causing a blockage with a resultant distention of the pelvis.

B. *Abnormal Kidney Motility:* It seems that the pendulum regarding kidney motility is gradually swinging back to a sane view of the subject. With the introduction of upper tract diagnosis, and the enthusiasm of the earlier workers upon the subject, the medical profession passed through a phase during which all movable kidneys were suspended and fixed. The operative procedure was to such an extent misapplied and so many kidneys were suspended through error in diagnosis, that the operation gradually came into great disrepute. Finally, it fell into the class of "meddlesome surgery."

With the refinements of modern technique that are now employed, such as pyelograms in the horizontal and upright position, serial pyelography and other procedures to determine the emptying time of the kidney pelvis and the routine employment of ureterograms, we are beginning to find that in certain selected cases kidney fixation is clearly indicated and produces excellent results. It is important in discussing renal motility that we should bear in mind the fact that a hydronephrotic kidney is a heavy kidney. Thus the increase in weight may be a predisposing cause of abnormal motility.

c. *High or Oblique Entrance of the Ureter into the Kidney Pelvis:* The ureter normally leaves the kidney pelvis at its most dependent portion and in this way gravity assists in the downhill drainage. If, however, the ureter passes out from the mid-portion or the upper half of the kidney pelvis, the drainage of the urine from the dependent calices is naturally uphill. Under such circumstances the musculature of the kidney pelvis works under the same strain as the bladder does when the vesical neck is pushed upward, and an analogous condition is produced. We are all familiar with the rapidity with which urinary obstruction develops if an abscess or neoplasm pushes up the region of the internal sphincter and thus creates a dependent non-draining bas-fond in the bladder. In those kidneys in which the ureter enters from the mid-portion or higher up on the kidney pelvis the residual urine of the kidney pelvis slowly and gradually increases. With this increase in weight there is a tendency to descent in the kidney. As brought out by Kelly and Burnam,[1] if the ureteropelvic junction be fixed, the lower pole of the kidney will rotate inward using the fixed point of the pedicle as its axis of rotation. Therefore, with the descent of the kidney there is a

corresponding ascent of the ureteropelvic junction; thus, more mechanical obstruction to the outflow of urine is produced.

FIG. 1. Hydronephrosis of right kidney in six-year old child, due to hypertrophy of smooth muscle of ureteropelvic junction. Before operation.

This ascent of the renal pelvis accounts for the ureters which at operation are seen to emerge from the uppermost point of the hydronephrotic pelvis.

D. *The Congenital Hypertrophy of the Circular Layer of Smooth Muscle at the Ureteropelvic Junction:* The normal ureteral wall consists of an outer fibrous layer, a central thick muscular coat and the mucous membrane lining the ureteral canal. The muscular coat is composed, in turn, of smooth muscle and is divided into three layers. The outer and innermost layers have their smooth muscular fibers running parallel to the course of the ureter.

FIG. 2. Kidney seen through transperitoneal nephrectomy wound. Posterior peritoneum has been opened, ascending colon and intestines have been packed out of operative field. Note that the ureter is normal below ureteropelvic junction, also great dilatation of vessels over hydronephrotic pelvis.

The middle muscle fibers are circular in their arrangement and their fibers pass around the ureter instead of up and down its wall. There are three points in the ureter where the middle circular layer of fibers reach their greatest thickness. These are: the ureteropelvic junction, the point where the ureter crosses the large vessels of the pelvis and the ureterovesical junction. Those who manipulate stones in the ureter are well aware of their decided tendency to become arrested at these three points.

If in the formation of the embryo the middle circular layer becomes abnormally hypertrophied, we have a condition of the ureteropelvic junction that is quite analogous to congenital hypertrophic pyloric

stenosis, which frequently is met with in the newborn.

It is with the hope of stimulating interest

Fig. 3. Child fifteen days after operation, showing abdomen returned to normal and healed transperitoneal nephrectomy wound. Dressing is over stab wound in lumbar muscles where drainage tube was brought out.

in the early recognition of this condition of childhood that the following case is reported. Early recognition before the destruction of the kidney has taken place would certainly be amenable to plastic surgery of the renal pelvis.

R. H., aged six, male. The patient was referred by Drs. E. P. Brunson and B. T. Talley of Albemarle, N. C., to Dr. Addison G. Brenizer, Charlotte, N. C., who was kind enough to help us with the operative procedure.

The patient's complaint was a mass in the right side.

Family History: The family history was
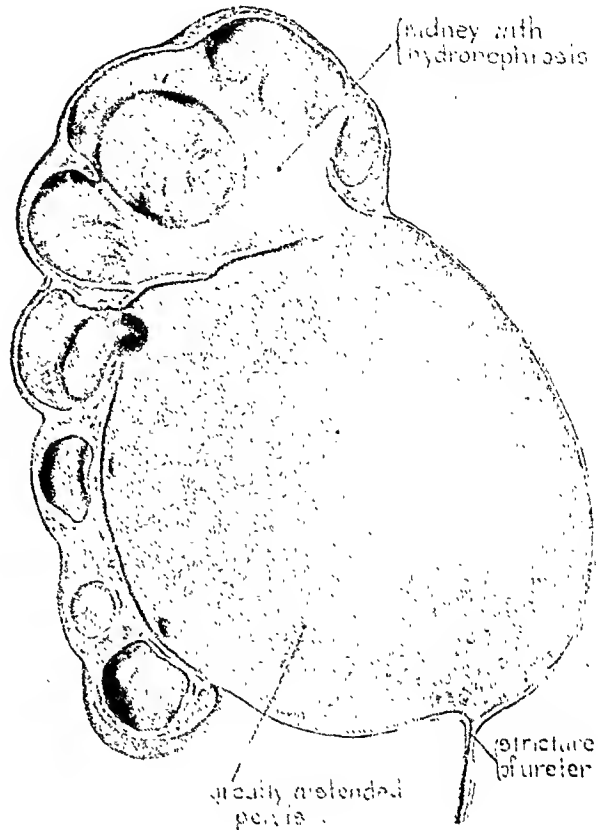
Wm. P. Didusch 1929

Fig. 4. One-half of hydronephrotic right kidney. Kidney parenchyma has been totally destroyed, save for a small remaining area in lower pole. Kidney, after operation, distended, held 1500 c.c. of fluid. Note great thickening of wall of ureteropelvic junction. This is caused by hypertrophy of circular musculature of ureteropelvic junction. Note also that lumen of ureter below this point is normal.

negative. His mother and father were living and well. There were two other normal brothers and sisters.

Past History: His past medical history was negative. At four years of age he was operated upon for appendicitis. He had measles, also, at four years of age.

Present Condition: The parents noticed that from time of birth, the child's abdomen was, apparently, larger than normal. It finally assumed the enormous proportions that existed on his admission (Fig. 1). There had been no headaches, or dependent edema. His appetite was good, he had had no gastric or intestinal upset, and had not lost any weight.

Examination: Temperature 98.6, respiration,

20, pulse, 70, Wassermann test was negative. White blood corpuscles 13,000, Red blood corpuscles, 4,800,000, Hb 66 per cent (Sahli).
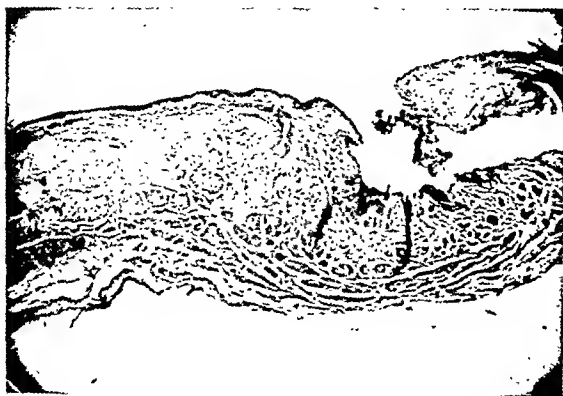
FIG. 5. Section taken through ureteropelvic junction. External and internal longitudinal muscle coats are of normal thickness. Tremendous hypertrophy of circular middle coat is very plainly visible. Portion of mucosa and underlying tissue has been torn up by artifact in right upper corner of section. No replacement of muscle by fibrosis or other evidences of infection in section.

Differential count polymorphonuclear 81 per cent.

The patient had great difficulty in walking due to his protruding abdomen. Recently the intra-abdominal pressure had become so great as to produce shortness of breath. The examination of the head and chest revealed normal findings.

Abdomen: The abdomen was very large and pendulous. The skin over it was quite tense. There were dilated venules over the costal margin with evidences of collateral circulation. There was made out over the region of the right kidney a very large movable mass that could be very definitely outlined; it was about the size of a normal adult head. It was not painful to pressure or movement. It was definitely fluctuant upon ballottement. A tympanitic note was present over the mass due to the intestines being pushed forward. The outline of the left kidney could not be made out. There was no free fluid or shifting dullness made out in the abdomen. The genitalia were infantile but normal in configuration.

X-Ray: Plain x-ray revealed no stones in the urinary tract. The left kidney shadow was larger than normal in proportion to the size of the child. The right side of the abdomen was covered by an indefinite shadow that evidently was fluid.

Cystoscopy: A child cystoscope entered the bladder easily. The study of the bladder and trigone was negative. A No. 4 catheter was passed up the right side but did not obtain any urine. Normal urine was obtained from the left kidney.

Laboratory Examination: Urine from left kidney showed specific gravity 1.024, 1 to 2 pus cells per high-power field. Culture of the urine from the left side showed no growth after twenty-four hours' incubation.

Urine from the bladder showed specific gravity 1.020, albumin, plus, glucose, negative, bile, negative, acetone, negative. Urine sediment showed 5 to 6 pus cells per high-power field, occasional casts.

Blood group No. 2 (Moss).

Intravenous Phthalein: Three minutes' appearance time. First half-hour 20 per cent, second half-hour 17 per cent, third half-hour 8 per cent, fourth half-hour 6 per cent to 51 per cent total for two hours.

A diagnosis of hydronephrosis of the right kidney was made and it was determined to do a transperitoneal nephrectomy.

Operation: The patient was draped for a right upper quadrant incision. An incision was made in the outer border of the right rectus muscle from the costal margin down to 3 cm. below the umbilicus. The bleeding points were clamped and tied with zero catgut. The rectus muscle was pushed over to the midline and the peritoneum was opened. The large tumor presented itself in the right flank with the ascending colon lying over it. The peritoneum over it was opened and the large pelvis of the hydronephrotic kidney became visible. The vessels over it were greatly enlarged. Due to its enormous size a trocar was introduced and 500 c.c. of clear urine were aspirated from the kidney. This greatly relieved the intrarenal tension and facilitated the isolation of the pedicle. The pedicle was doubly clamped, divided, and doubly ligated with No. 3 chromic catgut. It was then quite easy to separate the kidney from the surrounding structures (Fig. 2). The ureter was freed about 3 cm. below the ureteropelvic junction. It was not enlarged, its walls were not thickened and apparently was normal below the point of constriction. It was clamped, divided, and tied with No. 2 chromic catgut. A stab wound was made in the lumbar muscles and a tube sewed in place for drainage of the cavity from which the kidney had been removed. The incision in the posterior peritoneum was then closed with No. 1 plain

catgut. The abdominal wound was then closed. The anterior peritoneum was closed with No. 1 plain catgut. The muscles were closed with No. 2 chromic catgut. The skin was closed with interrupted sutures of black silk. No drainage was brought out of the anterior wound.

The child stood the operation well, and he was not shocked as a result of the procedure, probably due to the slow release of tension with a trocar. He left the operating table in excellent condition. His postoperative convalescence in the hospital was entirely uneventful. The wound promptly healed and he was discharged fifteen days after operation (Fig. 3).

About two weeks after his discharge from the hospital, he had an acute attack of tonsillitis and returned with symptoms of acute nephritis. He was treated medically for this and his symptoms quickly subsided; he was again discharged from the hospital.

He returned to the hospital six months after his operation in excellent condition.

Pathology: The pathological specimen consisted of a very large hydronephrotic right kidney. When refilled with fluid the kidney and pelvis held 1500 c.c. of urine. The specimen was split in half down through the ureteropelvic junction (Fig. 4). There was present great venous distention of the vessels lying over the pelvis. The parenchyma of the kidney was completely destroyed except for a very small remaining bit in the lower pole. At the ureteropelvic junction there was a very marked thickening of the wall of the ureter. Below the ureteropelvic junction the ureter was not distended and its wall was of normal thickness. Sections taken from the kidney showed com-

plete destruction of the normal kidney elements. A section taken from the ureteropelvic junction (Fig. 5) revealed the ureteral wall at this point to be composed of greatly hypertrophied smooth muscle fibers. These were circular in arrangement. There was no evidence of past infection, infiltration with lymphocytes, or fibrosis present. The outer longitudinal muscle coat was normal, as was also the submucous longitudinal coat. A part of the mucous membrane in the section was broken by artifact away from the underlying structures.

Conclusions: True congenital hypertrophy of the circular muscle layer of the ureteropelvic junction has been infrequently reported.

Most of the so-called congenital ureteropelvic strictures are inflammatory in origin and are not caused by muscular hypertrophy. Sections of these strictures usually show lymphocytic infiltration and fibrous tissue repair of the normal structures.

Due to the fact that the underlying pathology is not caused by infection in such cases, but is a congenital abnormality, in their early stages they should respond to plastic operations upon the ureter and pelvis.

As in the aforementioned case, after destruction of the kidney has occurred, nephrectomy is indicated.

[1] KELLY and BURNAM. Diseases of the kidneys, ureters and bladder. N. Y., Appleton, 1922.
[2] GERAGHTY, J. T., and FRONTZ, W. A. A study of primary hydronephrosis. *J. of Urol.*, 2: 161, 1918.

NON-OPERATIVE EXTRACTION OF URETERAL CALCULI*

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THE etiology of ureteral stone has, during the past decade, received a considerable amount of attention, but before the advent of the operating cystoscope and the present methods of pyelography with non-toxic opaque media, the causative factors which operated to produce these concretions were but dimly understood, and the ordinary location of the stones was so inaccessible even to radical surgery, that the whole subject remained almost hypothetical.

But as soon as modern instruments and radiologic observation could be applied to this especial aspect of urologic surgery, the majority of these obscurities were rapidly cleared up. A number of investigators, notably Hunner of Baltimore, scrutinized the ureter and gave us a world of information concerning its history and pathology so that most of the theories previously held had to be abruptly discarded, and speculation was replaced by scientifically conducted research. Hunner's work has centered especially upon ureteral stricture, and it is the existence of this condition which, in his opinion, is responsible for the vast majority of ureteral calculi.

At the very beginning of the present century, Rovsing, the late great Danish surgeon, wrote quite extensively on the subject of ureteral stone. These concretions he divided into two classes: (1) Those which form in the kidney and being expelled into the ureter, lodge in some portion of this duct; and (2) those which arise primarily in the ureter "because there has been caused a stasis of the urine by some type of stricture, perhaps a congenital valve formation, or again, because of a suppuration or ulceration due to the presence of the tubercle bacillus or some other inflammatory agent." It was Rovsing's contention that a deposit of hard particles

from the urine may be due to the presence of such an inflammatory process, which thus provides a nucleus about which calcareous deposits may gather. Either intra-ureteral or extra-ureteral factors may serve to induce stone-formation. In the first classification are the congenital valve formations and the inflammatory conditions already mentioned; in the second are tumorous growths or disease of the surrounding tissue. Once the calculus is formed, its presence will be evidenced by a wide variety of symptoms, but it is beyond the scope of this paper to undertake any discussion of these.

The Problem: Once the diagnosis has been made, we are confronted with the problem of removal. No less an authority than Braasch of the Mayo Clinic has stated that:

In all probability the majority of stones in the ureter pass spontaneously [and he cautions that] while no rule can be adopted, it would be rational in the great majority of cases, to wait at least two or three months until Nature has made several attempts to dislodge the stone. On the other hand, repeated violent colic, the danger of renal destruction, and other complications as the result of an obstructing stone may necessitate its removal before this period has elapsed.

The enthusiasm for operative removal of calculi lodged in the ureter has been steadily waning throughout the past two decades. As long ago as 1910, Deaver pronounced the open operation for the removal of a stone lodged far down in the ureter as having potential difficulties second to those of no other abdominal operation. Bransford Lewis, in 1912, gathered the histories of a number of cases where this operation was attended by very grave consequences, and Tenney some years earlier, in 1904, studied the mortality attending

this type of intervention and found it to be from 15 to 20 per cent. These figures have, fortunately, been much improved during the past twenty years, but the hazards still remaining are great enough to give us reason to avoid open operation whenever the removal of these calculi can be accomplished by any other means. The non-operative measures which are available in all but a few cases, may be listed as follows:

1. Catheter manipulation and ureteral dilatation, with or without the use of forceps.
2. Fulguration.
3. Injection of sterile oil or glycerine.
4. Incision of the ureteral orifice.

Catheter manipulation or the "teasing of a stone out of its niche with a catheter when hung in the ureteral orifice" has been possible since the invention of the operating cystoscope, but it is a method which can be successfully applied only to very small stones located near the vesical orifice. Dourmashkin states that he has frequently been able to overcome an obstruction caused by the presence of a stone in the ureter by the use of large-sized olive or even round-tipped catheters (Nos. 8 to 12 Charriere) and thus pushed the stone upward into the renal pelvis with comparative ease, "when catheters of small caliber and filiform bougies failed to accomplish this purpose. . . . In one instance the stone was carried at the tip of the catheter from its lodging place 2 cm. above the ureteral orifice to the pelvis of the kidney." When the stone has once been pushed up it has a tendency to drop down to the original site of obstruction so that this operator found that:

Whenever it is possible the best procedure in the treatment of non-impacted ureteral stones is to attempt to push up the offending agent into the dilated portion of the ureter by the use of large-sized catheters (7 to 11 Charriere) and immediately dilate the portion of the ureter below the stone by tapering ureteral bougies . . . 2 cm. long and tunneled to allow introduction of lubricants.

At the Mayo Clinic it has been observed that many stones if dislodged by a ureteral catheter will later on be passed spontaneously. "The stone becomes lodged in the ureter and subsequent colics may make its anchorage in the mucosa firmer. The passage of the ureteral catheter dislodges the stone, changes its axis, and the next colic forces it out."

Buerger passes several catheters into the ureter, and if he succeeds in getting them past the stone, leaves them there for some hours so that they may have time to become agglutinated to the stone. In this way he has on a number of occasions been able to withdraw the catheters with the stone attached through the bladder and into the urethra.

Dilatation of the Ureter: If carefully and persistently carried out, dilatation will serve to get rid of the great majority of ureteral calculi. Caulk attempted this method of relief in 96 cases, failing in only 8, which is certainly a gratifying small percentage. He dilated the vesical end of the ureter by the use of bougies up to size No. 11 French, still larger ones being used in a few instances. The bougies were sometimes left in place for a number of hours, or even over night. Lewis has devised a set of instruments for use with his operating cystoscope, the shafts of which are made flexible to permit of their use at an angle "around the corner" as well as by the direct method, and similar equipment now accompanies most of the standard cystoscopes. The practice at the Mayo Clinic is to forcibly dilate the stricture below the stone in the hope of being able to grasp it with forceps when its position has been altered.

A method of dilating the ureter by means of rubber bags has lately been put forward by Dourmashkin. By it he claims to be able to accomplish dilatation of the ureter to almost any desired size, and to dispense with the bulky ureteral dilators which necessitate the slitting of the meatus in many instances, besides requiring the highest kind of manual dexterity which often cannot be commanded at any cost. In

order to insert the bag easily, he has found it necessary to plan a modification of the present model of the cystoscope ordinarily used, but in the instrument so modified, its use is simplicity itself, and he believes that intra-ureteral manipulation of calculi will be greatly facilitated by the employment of this device.

While concurring in the opinion that many cases of ureteral calculi should be treated conservatively, Bugbee, addressing the American Association of Genito-Urinary Surgeons a few years back, emphasized how greatly the judgment of the individual surgeon must be relied on to decide what is the best course in any given case. For example, a calculus impacted in a ureter with a hydronephrosis above, should be removed by operation, unless it can be at once dislodged by manipulation, and the same is true when the kidney above is infected and symptoms of septic absorption are present. Yet this author has found that the simple shifting of the axis of a small calculus by manipulation with ureteral bougies or catheters, or sometimes retention for twenty-four hours of the ureteral catheter which has been slipped by the stone, aided by the propulsive force of the urine, and the enlarging of the ureteral orifice with a cut at its superior margin with the fulguration wire, is all that is needed to secure passage of the stone in nearly all cases.

During the war period, Bugbee published two papers in which he made mention of an ingenious method of extracting ureteral calculi which appears to have served him well on numerous occasions. By boiling the catheter or bougie it may be rendered soft enough to pass through almost any kink or coil about a calculus, and may thus be made into a loop, which can be thrown around the stone and thus serve to withdraw it as in a sling. The catheter is twisted in the fingers and gentle but firm traction applied.

Fulguration: This has been successfully employed by numerous writers, and is in use under certain rather restricted conditions in most of the prominent urologic clinics. By this agent the less dense stones may sometimes be disintegrated, and in those cases where it is found necessary to wound the ureteral wall, the fulguration spark will be found useful for the control of bleeding.

Injection of Oil and Local Anesthetics: Some years ago, Crowell of North Carolina injected 2 c.c. of 2 per cent solution of cocaine at the site of an impacted stone, simply for the purpose of relaxing the muscular fibers and lessening the pain attendant upon an effort to remove the obstruction. The resulting relaxation was so marked that within three minutes a catheter was easily passed beyond the stone. After the injection of 10 c.c. of sterile olive oil, the catheter was removed, and the following day the stone was found in the bladder. The following technique was worked out as a result of this event, and put into practice at the Crowell Urological Clinic.

A roentgenogram is made of a No. 5 bismuth-filled catheter passed into the affected ureter until it meets with resistance. The x-ray picture gives further evidence of the size and location of the stone, and if urine flows from the catheter it demonstrates that the obstruction is not complete and the kidney still active. Two cubic centimeters of a 2 per cent solution of cocaine are then slowly injected at the site of impaction, and three or four minutes later the catheter is passed beyond the stone, and 10 c.c. of sterile oil injected. Should the catheter fail to pass, the force of the oil injection is increased, in the hope that the stream may dislodge the stone, or at any rate, facilitate its passage by lubrication and dilation of the lumen of the ureter below the impacted calculus. "The patient is kept well under the influence of morphine, put to bed and instructed to drink water freely to stimulate the functional activity of the kidneys, and in this way assist in expelling the stone." Hexamethylenamine should also be used very freely.

If the patient is tolerant of instrumentation, this procedure can be repeated every second or third day, increasing the size of the catheter so as to keep up an increasing dilatation of the ureter. Up to No. 14 F. may be safely employed; but if the stone is not passed by the time this size is reached, the need of surgical intervention is apparent.

The advantages of oil injection do not weigh very strongly with Braasch of the Mayo Clinic, who remarks that "It is difficult to conceive how the natural efforts of peristalsis or the natural lubrication in the ureteral mucosa could be improved on."

Incision of the ureteral orifice may often be all that is necessary to permit the passage into the bladder of a stone lodged near the vesical end of the ureter. Frequently the opening into the bladder will be found on the first examination to be so small that it must be enlarged before intra-ureteral procedures of any sort can be undertaken. Through the operating cystoscope the orifice can be readily incised with the ureteral scissors. As Dourmashkin has said: "This is a harmless procedure, and the little bleeding incident to it may be easily controlled with the fulguration spark." In a series of 60 cases, this author found it necessary to employ ureteral meatotomy twelve times and in no instance were there untoward results of any description.

Catheter manipulation and ureteral dilatation is the method which is commonly employed at the James Buchanan Brady Foundation, Urologic Department of the New York Hospital, and its application is illustrated in the following cases which are selected from a series of more than 50 recently seen at that clinic.

CASE REPORTS

CASE I. R. S. Jewish housewife; aged thirty-three, mother of six healthy children. Mother died of kidney trouble; childhood and family history otherwise negative.

Fifteen years ago, left nephrectomy for large hydronephrosis; health fairly good since this operation until six months ago when blood, and occasionally pus, appeared in the urine, accompanied by severe right lumbar pain.

Immediately after cystoscopy and right ureteral dilatation, the patient was able to pass a stone about the size of an orange seed. An x-ray exposure was then made and another cystoscopy done, both catheters being passed through the right ureter to the kidney pelvis. An irrigation of 1:2000 aeriflavine was given. The patient suffered a severe chill after these manipulations and during the passage of the calculus, and complained greatly of pain during the succeeding night. Her condition, however, improved steadily until her discharge on the fifth day. As the urine showed a Bacillus proteus infection, she was instructed to return weekly for further dilatation of the ureter and irrigation of the remaining kidney pelvis.

CASE II. P. D. Male, aged fifty. The present illness began four months before entrance with a sudden acute attack of pain in the left kidney region, radiating to the right testicle. During the day there were several attacks lasting about fifteen minutes. A little blood appeared in the urine, but the stream was unobstructed, and micturition did not cause pain. Two months later there was a similar attack, but more severe and lasting for eight hours, so that morphine was necessary for relief. There was considerable hematuria at this time, as well as in two further attacks which occurred about a week apart two months later. No stones were passed during any of these attacks of colic.

The physical examination on entrance showing nothing of importance save several carious teeth, and a marked phimosis, with abnormally small testicles. Neither kidney was palpable, but there was some complaint of pain on palpation in the renal region. No tenderness over the bladder.

Cystoscopic examination showed a markedly trabeculated fundus, a normal ureteral orifice on the right, but the left one somewhat edematous. No. 6 F. catheters were passed through both orifices, that on the right reaching the pelvis without difficulty. The larger instrument failing to pass on the left, No. 5 F. was substituted, and this progressed 2.5 cm. from the orifice. Phenolsulphonephthalein injection was returned on the right side only, appearing in eight minutes, and giving a total of 3 per cent, ten minutes after appearance.

X-ray with double exposure (Kretschmer test) showed stone, in contact with the catheter, about 2.5 cm. from the ureteral orifice.

Four days later another cystotomy showed the left ureteral orifice edematous and bulging, with a "mulberry stone" as large as an olive-pit extending from it. This calculus was first manipulated with a bougie, and not being dislodged in this way, the cystoscope was withdrawn, and the Lowsley operating-irrigating rongeur inserted in its place. With this instrument the stone was easily grasped and removed entire. Eleven days later, another examination showed slight sloughing at the site of lodgement of the stone, but the catheters passed readily on both sides. Both pelves were irrigated at this time, and specimens examined to determine whether there were a persistent infection of the kidneys. Five subsequent dilatations and irrigations were carried out at intervals of one or two weeks. At the second dilatation, the left catheter was obstructed after 7.5 cm. and culture of the bladder urine showed Staphylococcus albus. A week later, however, the catheter passed readily on this side and a No. 7 F. bougie was likewise inserted beside a No. 6 F. catheter. There was no further obstruction, or urinary infection.

CASE III. A. Z., Male, entered with a complaint of hematuria, renal pyuria, and left-sided lumbar pain. On cystoscopy, a No. 7 F. bougie, and No. 6 F. lead catheter passed to the left kidney pelvis, and an x-ray was taken with catheters and cystoscope in position. B. coli communis was demonstrated in the urine. An irrigation of 1:1000 acriflavine was given to both pelves.

The x-ray report at this time showed the left kidney to be large but in good position, with a shadow at the upper border of the twelfth rib, apparently in the left kidney pelvis. Right kidney normal in position and size. Two weeks later a No. 6 F. catheter and a No. 7 F. bougie were passed to the renal pelvis on the left, and a No. 6 F. bougie was run in besides these for a distance of 10 cm., where its further progress was obstructed. The specimen from this ureter still showed B. coli communis. After the lapse of another fortnight, although the catheter passed to the left pelvis, the first bougie inserted, No. 7 F., was stopped at 7 cm., and a second No. 6 F. bougie was stopped at only 4 cm. Irrigation was given at each session. After another two

weeks' interval, No. 6 F. catheter and bougie passed through the left ureter only to 12 cm., at which point they were obstructed. Acriflavine irrigations were kept up because of continued urinary infection. At the next session the catheter was stopped at 7 cm., but the bougie could be passed by it into the pelvis.

Another x-ray taken after the seventh dilatation did not show the darker shadows visible in the previous roentgenogram, but in contact with the catheter on the left side, opposite the fourth sacral foramen, was a shadow, apparently of a stone about the size of the end of one's little finger. The eighth dilatation permitted the No. 6 F. catheter to pass only 5 cm. although a bougie of the same caliber passed beside it for a distance of 10 cm. After a two weeks' interval, the catheter was stopped at 7 cm., but after some manipulation, the bougie was passed completely to the pelvis. The cystoscope was now removed and the bougie and catheter left in the ureter, being held in position by strips of adhesive plaster attached to the penis. The patient was kept in the hospital over night, in the hope that the stone could be made to pass. This was unsuccessful, and the next roentgenogram showed there was still a shadow in contact with the catheter, about 3 cm. from the bladder wall, and 5 cm. from the ureteral orifice of the left side.

Finally, four months after the dilatation were begun, No. 6 F. lead catheters passed to both pelves without any obstruction showing that the stone which had blocked the way had been passed.

This case has been given in detail to illustrate how much patience and hopefulness will sometimes be required on the part of all concerned before non-operative manipulation will bring about a successful result.

CASE IV. J. D. Male. No. 6 French catheter passed for a distance of 10 cm. on the right side and 8 cm. on the left. Both ureteral orifices appeared normal. Phenolsulphonephthalein intravenously injected appeared on each side in six minutes, the total amount secreted after ten minutes being 11 per cent on the right side, and 10 per cent on the left. Roentgenogram (Kretschmer test) gave a left kidney shadow normal in size and position. The right kidney shadow was likewise normal, but in contact with the catheter on the left, opposite the fifth sacral foramen, there was a

seaphoid-shaped shadow which moved exactly with the eatheter in the double exposure plate.

A seeond exposure was made five days later;

FIG. 1, CASE IV

the catheter was arrested at 8 cm. The ureteral instruments were left in plaee, and the patient kept in the hospital over night in the hope that the stone would be induced to pass, as the roentgenogram and slight impairment of renal funetion indicated that it was of small size. This hope was not realized, however, and five days later the patient suffered a severe renal eolic lasting twelve days. At the third examination, three days after the attaek of eolie, a eareful scarch was made of the bladder, but no stone could be found. A catheter and bougie, each No. 6 F. and a No. 7 F. bougie were passed into the ureter but could be made to advance no further than 3 cm. This indicated that the stone had been forced downward by the attaek of eolie, and the prospect of its expulsion scemed good.

However, examination three weeks later showed that while a No. 6 F. bougie eould be passed all the way to the left renal pelvis, a second bougie and catheter of the same caliber were arrested at 7 cm. After the lapse of another week, the seeond bougie and the eatheter stopped at 5 em. No further dilatations are recorded until nine weeks later, when the No. 6 F. eatheter reached the pelvis,
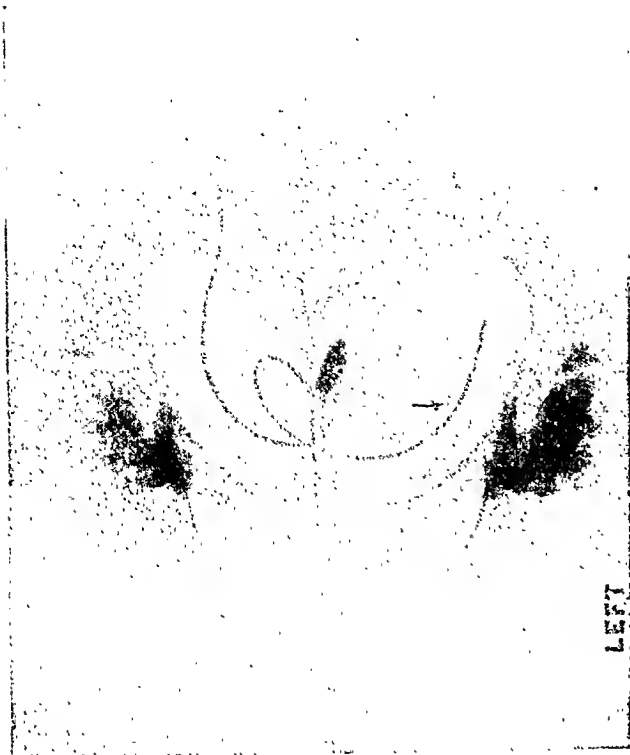
FIG. 2, CASE IV

FIG. 3, CASE IV

on this occasion it was only with great difficulty that a No. 6 F. catheter of lead was passed to the pelvis on the left side. A bougie of the same caliber which was pushed in beside

while two bougies of the same size were arrested at 5 cm., thus making a dilatation of 18 F. for the 5 cm. of ureter below the site of the stone. Two weeks thereafter, a No. 7 F.

catheter passed entirely through the ureter, while two No. 6 F. bougies were arrested at about 3.5 cm. In another fortnight bougies

FIG. 4, CASE V

the pelvis, and a roentgenogram was reported as showing no shadows such as had been evidenced on the previous plates; the patient had evidently passed the stone, as it was not shown in any portion of the ureter, or in the kidney pelvis.

In this case, twenty-three weeks of persistence were required to eliminate a small stone which appeared easily removable at the first examination.

CASE V. Mrs. S. entered with a complaint of hematuria, pyuria and renal pain. On cystoscopy, the appearance of the bladder was normal and the catheters, No. 6 F., passed to each pelvis without difficulty. Phenolsulphonephthalein 4 per cent on the right side, appearing in five minutes, 17 per cent on the left side, appearing in four minutes. Pyelogram of the right side (Kretschmer test) indicated a stone in the ureter on this side. Two weeks later, three No. 6 F. bougies were passed through the right ureter to the point where the roentgenogram had indicated that a stone was located. Two weeks later, Nos. 6 and 7 F. bougies passed through the right ureter to the pelvis, but a second No. 6 catheter
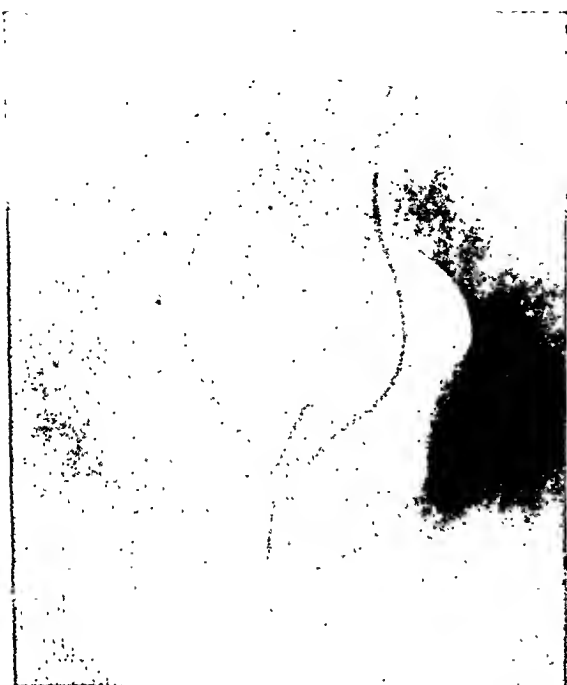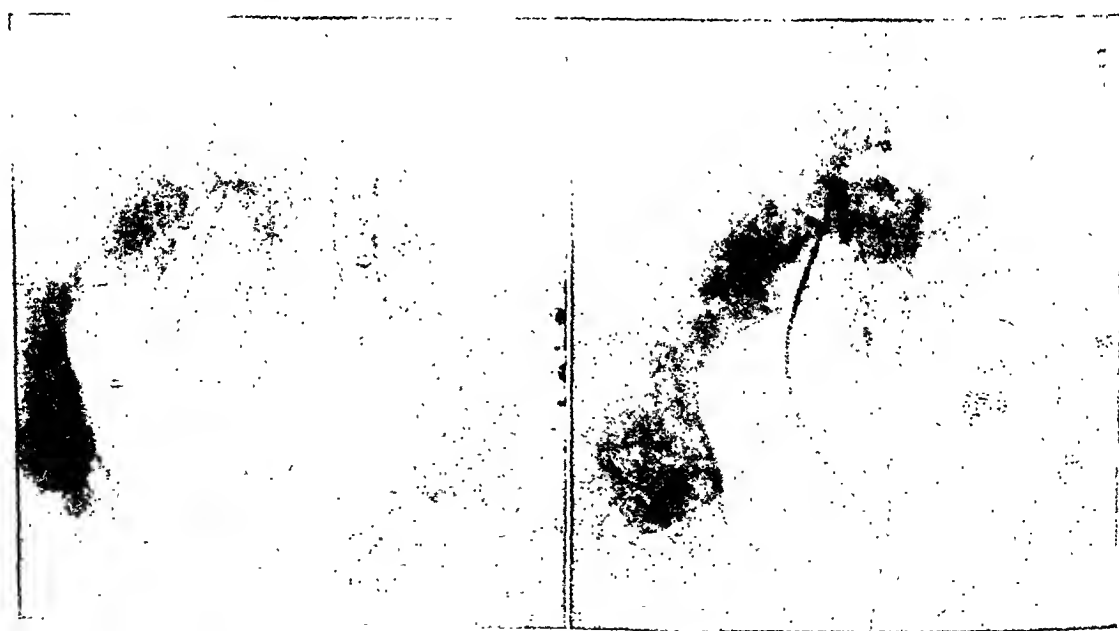
FIG. 5, CASE V

FIG. 6, CASE V

No. 6 and 7 reached the pelvis, but a third instrument of the same size was stopped at 2.5 cm. After four weeks the third bougie could be advanced as far as 15 cm. and a few days thereafter, all the instruments reached

was stopped at 5 cm. The patient could not tell whether or not she had passed the stone.

X-ray with the Kretschmer double exposure showed a shadow in contact with the right catheter, which moved exactly with the

instrument. Ten days later, however, both catheters passed to the renal pelves without obstruction.

CASE VI.   J. H. M., male, entered with complaint of right-sided pain and hematuria. Cystoscopy showed a good sized papilloma in the middle of the trigone near the fundus. Both ureteral orifices were somewhat congested, the left more than the right. No. 6 F. catheter passed for 5 cm. on the left, but could not be passed on the right. The No. 5 with which it was replaced entered the right ureter for a distance of 10 cm. No. 5 F. finally passed the obstruction with a grating sound when inserted on the left, and progressed all the way to the pelvis. Phenolsulphonephthalein appeared on the right side in three and a half minutes, on the left in four and a half minutes; total amount secreted in ten minutes after appearance, 8 per cent on the right, 3 per cent on the left.

One week later the papilloma was cauterized and disappeared. At the same cystoscopy, No. 7 F. bougie and No. 6 F. catheter passed to the pelvis on either side. A roentgenogram taken a week later showed a shadow on the right side in contact with the shadowgraph catheter, opposite the end of the sacrum; this was constant in both pictures. A right pyelogram showed slight shagginess of the calices, and while there was no evidence of dilatation in the right pelvis, its ureter was distorted and considerably dilated, with a right-angle kink opposite the body of the fourth lumbar vertebra. Dilatation was in evidence only *above* the shadow. At this same sitting No. 6 F. catheters passed in both ureters for a distance of 10 cm. When these were replaced by No. 7 bougies, it was possible to reach both pelves.

A week later obstruction was encountered on the left, neither catheter nor bougie progressing more than 7 cm. after several trials. At two subsequent sittings at weekly intervals, it was possible to penetrate the ureter for only 5 cm. After a third week, two No. 6 F. bougies passed together to the left kidney pelvis. At the end of the fourth week the instruments were obstructed at 3 cm. and the obstruction remained at about this level for another fortnight. At this time, No. 6 F. bougies were halted after being inserted 11 cm. into the right ureter. One week after this Nos. 6 and 7 could be passed 4 cm. on the left side.

Three weeks later it was found that the stone on the left side had moved from 5 cm. to 2 cm. from the orifice, and in another week all the instruments passed without obstruction to the left pelvis. A fortnight later the pelvis on either side was reached without difficulty and the roentgenogram showed no shadows. The patient, however, continued to have pain in the region of the lower left ureter.

CASE VII.   A. D., female, aged fifty-seven, came to the Clinic with a history of "bearing-down pains" in lower abdomen and renal region for a year past; four months before, there had been a sharp attack of pain in the right kidney region, quickly shifting to the corresponding point on the left. Since this time there had been frequent attacks of left-sided pain. Two months before hematuria had been in evidence for one week. Since the onset one year before, the patient had been obliged to rise twice, or even as many as four times during the night to urinate, with a daytime frequency of five or six times. There had been occasional burning pain on micturition. The only significant point in the previous personal history was that there had been an operation for the removal of uterine fibroid tumor at the age of twenty-seven. On physical examination extreme tenderness was evidenced in the region of the left kidney, and along the course of the left ureter. On cystoscopy, the stone was found in the left ureter, and a catheter left in place, while the patient was kept in the hospital in the hope that the stone would pass. This maneuver was successful, for the stone descended to the bladder, whence it was removed by the aid of the Lowsley rongeur, the woman being discharged cured at the end of five days.

The contrast between this case and Case IV where more than five months elapsed before the stone could be coaxed to leave the ureter emphasizes the uncertainties which attend this method of handling ureteral calculus.

In conclusion, I would emphasize the wisdom of exhausting every possible means of non-operative removal before attempting surgical intervention upon a ureter blocked by calculus. Clinical experience in many different places which covers a considerable number of years, has shown that

with care and persistence even in the face of discouragement, our efforts will practically always be rewarded by the passage of all but the very largest stones. The patient's cooperation is a very important factor in the eventual success, but this is easy enough to obtain once he comprehends that an effort is being made to obviate the suffering and hazard of an abdominal operation, to say nothing of the minor, but none the less interesting, consideration that he will avoid the expenditure of time and money incident to hospitalization for the intravesical procedures can all be carried out in the office.

Another point which is an important future consideration is the avoidance of stricture of the ureter, which is so often a sequel to the formation of scar tissue in operative wounds. All these considerations may be brought to the patient's attention, should he find continuous transvesical inspection irksome, and the repeated passage of instruments tedious and painful.

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PROGRESSIVE POSTOPERATIVE GANGRENE OF THE SKIN*

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WITHIN a year, 4 patients having progressive subcutaneous gangrene, 3 of them in advanced stages, came on our service at Harper Hospital. This number of these rare cases, as well as the poorly outlined treatment they received before the progressive gangrene was stopped, leads us to discuss the topic. In spite of the few literary contributions on the matter which bring out the importance of differential diagnosis and the kind of treatment needed, the subject is still unknown to many surgeons. While the affection has been rarely reported, verbal communications with busy colleagues show that almost every surgeon has seen one, two, or more of these dire wound complications. This fact is also stated by Meleney, who personally has seen more of such cases than any one else, and who has contributed the best articles, but perhaps has included cases not strictly belonging to this group. Meleney also states that many surgeons have seen such cases, without reporting them, or recognizing their importance.[1] Meleney himself in five years saw 14 cases, 7 of them at the Presbyterian Hospital.

NOMENCLATURE

The following titles have been used in publishing these cases:

Progressive Enlarging Ulcers of the Abdominal Wall. Cullen.

Severe Spreading Carbunculus Infection of the Chest Wall. Christopher.

Progressive Gangrene Infection of Skin and Subcutaneous Tissues. Brewer and Meleney.

Progressive Gangrenous Ulceration of the Abdominal Wall. Shipley.

Postoperative Progressive Gangrenous Infection of Skin and Subcutaneous Tissue. Probstein and Seelig.

Progressive Gangrenous Ulceration of the Abdominal Wall. Gordon.

Gangrene of Abdominal Wall. Horsley.

Hemolytic Streptococcus Gangrene of Skin. Frank and Meleney.

Postoperative Spreading Superficial Gangrene. Alexander.

Of 14 cases of progressive gangrene of the skin, 10 of them gathered from the literature, 4 of our own, 11 were men, 3 were women. The youngest patient was four years old, 1 was eight, another eighteen, 3 between thirty and forty, and 7 past fifty years of age. The first signs of the gangrene appeared from the second to the seventh day after an operation. Six of the 14 cases of gangrene followed operation for appendicitis with drainage; 2 followed drainage of abdominal wall abscess, probably also appendiceal in origin; 2 followed drainage of a post-pneumonic empyema; 1 the amputation of a female breast for multiple abscess; 1 in the injection wound of scarlet fever serum in the buttocks; 1 in the drainage wound of an inguinal gland abscess; and 1 in a fistula of suppurative epididymitis.

Definition. A good description of this type of gangrene given by F. N. Gordon is as follows:

Practically always following operation for appendiceal abscess, on the third to the tenth day, the ulceration spreads from the site of operation over the abdominal surface. The ulcer is described as carbuncular-like, spreading, serpiginous, gangrenous, etc., and as being very intractable, resisting all the ordinary measures adopted to promote healing. Spreading with great rapidity at first, this slows up as the ulcerated surface widens, and there is a tendency for the part first involved to heal. The effect of this is to have the ulceration separated from and apparently distinct from the original operative wound which may now still be draining or may be a healed scar.

The ulceration extends from the skin downward to the deep fascia. The temperature is moderately elevated, usually from 99° to 100°, with occasionally 101°. The pulse varies from 100 to 120—leucocytes seldom go over 15,000. The appetite is usually good. The local condition is very painful and the change of dressings is accompanied by great discomfort.

Generally the gangrene is accompanied by a moderate discharge and progresses by burrowing and undermining the skin edges in the subcutaneous tissue. The process spreads about 4 mm. a day (Alexander) advancing in serpiginous lines. Very intense pain was mentioned in 9 of the 14 cases. In 1 case reported by Christopher, the pain was so severe that practically all dressings had to be done under gas anesthesia. The fever usually is slight and rarely rises above 102° F. As a rule, 100° is the limit. The greatest extent of the final gangrene probably is in the 2 cases following empyema, where the gangrene extended from the scapula down beyond the buttocks, forward to the navel and backward to the midline. In the cases following appendicitis, the skin of one-half of the abdomen often sloughed away, and in 1 case it extended even beyond the buttocks to the loin. In our scrotal case, practically all the skin on the left side of the scrotum was lost.

Duration Up to Healing: The time from onset to healing was from two months to twenty-two months. In the 14 cases gathered by us, not one patient died.

DIFFERENTIAL DIAGNOSIS

This superficial gangrene should be distinguished first from common wound infection, erysipelas, and then the more severe sloughing gangrenes of the abdominal wall which follow gas bacillus infection from the intestines. Simple wound retention and erysipelas on the first day will perhaps look somewhat like the gangrene under consideration, but will not have the rather insidious onset and the erysipelas and retention in wound will not lead to progressive gangrene.

Postoperative gas bacillus infection of the abdominal wall[2] comes with much more severe symptoms than does superficial gangrene. The patient is prostrated. The skin around the wound is brownish, edematous, and there is a foul-smelling discharge, also crepitation from gas around the wound and positive bacterial findings of gas bacilli (Welchii). Obviously, the prognosis for this type of gangrene is much more serious than for the progressive cutaneous gangrene. The chapter on this more severe gas infection of the abdominal wall has been covered by Butler, Jennings, Winter, Russell, Bier, and others.

Horsley[3] reports a case where practically the whole side of the abdominal wall sloughed following an intestinal resection for intussusception with intestinal polyp. The process started right away with massive death of the tissues, in which the skin and subcutaneous tissues were less affected than the muscles were. While the culture did not show gas bacillus, it showed chains of streptococcus, gram positive diplococci, colon bacilli, the latter suggesting that we were not dealing with cutaneous gangrene but with sloughs produced by colon bacilli of intestinal origin.

The gangrene which we are discussing does not extend deeper than the skin. It is also doubtful whether the cases mentioned by Meleney in his first publications, in which he gives his experience in China, on gangrene of the skin of the legs following scratch wounds (over 20 cases reported), should really come under this group, as the conditions he mentions had to be taken care of by deep incisions, pointing out that the infection traveled more in the deep tissues than in the skin proper.

On the scrotum, a moist gangrenous process, which is also very fatal, produced a sloughing of the scrotum within a day or two. Many of these patients die within three or four days. The origin of this process is considered a breaking down of deep diverticula of the sigmoid, followed by infection of the lateral wall of the bladder,

and then following the arrangement of the fascial planes, the infection penetrates near the urethra into the perineum and scrotum. During the past two or three years we have had 2 such cases at Harper Hospital. These were in middle-aged men brought to the hospital with acute black slough of the scrotum and some gas formation in the tissues, in a condition of severe sepsis, and giving the picture of a perforated urethra. Neither of these patients had any trauma or history of any stricture that could have accounted for the severe septic infiltration of the tissues. Both patients died. I have no doubt that the article mentioned makes clear that these acute gangrenous processes of the scrotum are due to anaerobic bacteria from a perforating diverticulum of the bowel.

This is an entirely different process from the rather dry gangrene in our case of gangrene of the scrotum, which was entirely limited to the skin and lasted several months before it was stopped. The two types of gangrene of the scrotum have the same relationship to each other as gas bacillus of the abdominal wall has to the cutaneous gangrene under consideration. Such a case as ours of cutaneous gangrene in the groin following drainage of an inguinal lymph gland abscess might suggest the presence of granuloma inguinale, but this was easily excluded by the failure to find Leishman-Donovan bodies.

The progressive postoperative gangrene is usually a gangrenous process following the drainage of a wound within three to ten days, sometimes later, but is characterized by slow, burrowing, subcutaneous advance of the gangrene, destroying the skin, but not going into the deep tissues.

ETIOLOGY

All authors writing on this ulceration have endeavored to find a specific germ causing it. Cullen found Streptococcus brevis. Christoper in his case following empyema found gram positive cocci plus hemolytic streptococci. Brewer and Meleney mention first their finding of a large variety of organisms, without any definite conclusions as to the pathogenicity. In a second case they found hemolytic staphylococcus with diphtheroid bacilli in aerobic culture and streptococcus in anaerobic, etc. Nearly all the authors found several varieties of organisms in aerobic and anaerobic cultures in these gangrenes.

Meleney and Brewer report an extensive study on the etiology and found that with hemolytic staphylococcus aureus and diphtheroid bacilli from one of their cases, they could produce in animals, by the injection of cultures of these two bacilli, gangrene around the place of the injection when both bacilli were injected together; but no ulceration would follow if one of the organisms was injected alone. The conclusion of Brewer and Meleney after experimental studies was: "The infection with streptococcus prepared the way for the gangrenous process, but for its actual production a second organism was necessary, in this case the Staphylococcus aureus."

Shipley reached the same conclusions, namely that the combination of the two organisms causes an increased virulence of both, and leads to sloughing gangrene, and he believes that such symbiotic action of the two organisms is the cause of the gangrene.

From an etiological point of view, the case of Meleney of hemolytic streptococcus gangrene following the administration of scarlet fever antitoxin is very interesting. An eight-year old girl, seven weeks before her admission to the Presbyterian Hospital in New York, was given a prophylactic dose of scarlet fever serum, in the right buttock, because an older sister had come down with the disease. Four days later she developed typical scarlet, with fever, sore throat, and rash. She was then given a large dose of scarlet fever serum in the left buttock. On the second day the swelling caused by this injection increased, and on the fourth day the skin became dusky and bullae and blisters formed, and frank

gangrene followed over the whole left buttock, thigh and across the abdomen. A complete cure was established from the
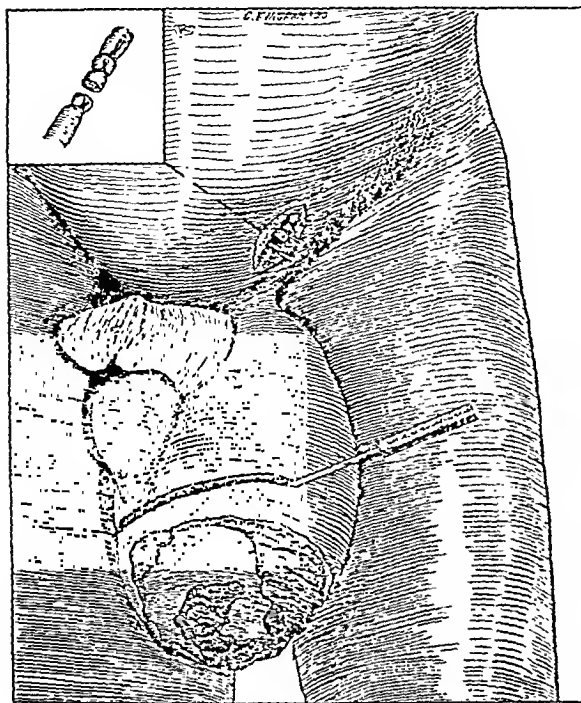
FIG. 1. Gangrene of scrotum (accompanying cystic liver). Date of operation, Jan. 23, 1930.

gangrenous process by incision and skin grafting.

The etiological consideration of Meleney reads as follows:

The exceedingly rapid development of necrosis in this type of streptococcus infection resembles strikingly the necrosis which takes place in experimental animals which have been made hypersensitive or allergic. Hypersensitivity to bacterial products resulting in necrosis of tissue has at least two different manifestations. First that which Zinsser and Grinnell, Mackenzie and Woo, Julianelle and Avery and others have described which consists of a phase of hypersensitivity in the course of repeated weekly intradermal inoculations of bacterial extracts or autolysates coming on about three to four weeks after the first injection, lasting a week or ten days and then passing off. The second hypersensitive manifestation is that which has recently been observed and studied by Shwartzman. He has found that when filtrates of certain organisms are injected into the skin of animals,

there is little or no primary reaction, but twenty-four hours later, if the same filtrate be injected into the vein of the animal, the areas of previous intradermal injection within a few hours become swollen and red and then certain portions turn blue, blisters form and frank gangrene of the tissues develops. This phase of hypersensitivity only lasts for about twenty-four to forty-eight hours after the primary inoculation, but the reaction is more severe than in the other type.[1]

Meleney's patient was in a hypersensitive stage on account of previous prophylactic antitoxin injection, and the second injection in the other buttock, during this sensitization, led to gangrene.

With the observations of Arthus and others, it is well established that frequent cutaneous necrosis occurs in rabbits and guinea pigs that have been used repeatedly for injections of bacterial and protein products.

CASE REPORTS

CASE I. T. S., aged eighteen, male, colored, single, entered Harper Hospital for the first time January 4, 1930, complaining of swelling of the left side of scrotum for one and a half years. The history is that of gradually increasing swelling of the left side of scrotum, associated with vague pain. For the past two months there had been a gradually spreading ulceration, starting as a boil. There had been a painless mass in the upper abdomen since infancy.

Physical examination showed a large swelling of the left testicle with a sloughing area in lower part of scrotum 4 × 4 cm., covered with grayish necrotic base (Fig. 1). There was a smooth, now tender, mass in the upper abdomen extending to within 2 in. of the umbilicus. Blood Wassermann reaction four plus.

Operation, January 23, 1930: With cautery knife the ulcerated area was excised with wide border, after we first divided the spermatic cord in inguinal region. Testicle and cord. Drained through upper wound.

Patient left hospital on February 3, with only slight discharge from wound.

Patient received potassium iodide last ten days in hospital.

CASE II. Mr. H. P., aged fifty-four, male,

white, entered Harper Hospital May 2, 1927, with lobar pneumonia and pleural effusion, left.

FIG. 1A.

May 5, was tapped and 20 c.c. straw fluid removed.

May 13, rib resection, left eighth rib, posterior, 8 oz. pus obtained, streptococcus by culture.

FIG. 2.   FIG. 3.

FIGS. 2 and 3. Gangrene of skin following drainage of empyema.

June 6, 1927. Carbuncle or sloughing area just above wound in chest, about 3 in. in diameter.

July 29, 1927. Edges of slough excised. Had spread all around incision to an area 6 × 10 in.

August 11, 1927. Necrotic edges of whole border of very large carbuncle on left side of thorax excised.

The sloughing area continued to spread in spite of the repeated excision of edges, until sometime in January, 1928, when healing began, which was practically complete by April 7, 1928 (Figs. 2 and 3).

Patient last seen on January 3, 1930. Still had discharging sinus in thorax.

CASE III.   J. F., aged four, male, white.

This patient was first seen on May 14, 1927, when he had an abscess in the left inguinal region of one week's duration. The abscess was incised and drained with a rubber tube. On draining, sinus continued to discharge pus, and there was a sloughing area around the wound. The patient was seen by several other physicians at the Ford Hospital and at Grace Hospital, but the ulcerated area in the left groin continued to drain in spite of all treatment.

Patient again came under our care on August 24, 1928 and from that time until March 17, 1929, he was in Harper Hospital under treatment, light treatment, x-ray curetting, cauterization, skin grafting, and high caloric diet

FIG. 4. Gangrene of skin following drainage of suppurative lymphadenitis.

being used, and he was finally discharged from the hospital, healed, save for a small area which subsequently closed in well. (Photograph was taken in December, 1929, Fig. 4.)

Various diagnoses were made during the course of treatment such as tuberculous granuloma inguinalae and phagedenic ulcer,

FIG. 5.

but at no time was the diagnosis of tuberculosis confirmed and guinea pig inoculations were negative.

CASE IV. Mr. H. S., aged fifty-two, male, white. Insurance dealer.

Entered Harper Hospital, December 24, 1929 for the first time with the story that four weeks before he had been operated upon for gangrenous appendicitis. The wound was drained with one cigarette wick, which was removed after two weeks. About this time a gradually spreading ulceration of the abdominal wall developed.

Past and family history, irrelevant.

Physical examination negative save for a semicircular sloughing area with granulating base above the oblique incision in right lower quadrant (Fig. 5).

Operation December 25, 1929. The gangrenous area and 2 cm. border of healthy tissue excised with electrocautery knife down to deep fascia.

Postoperative course: Wet bichloride dressings twenty-four hours, then vaseline dressings.

December 30, Thiersch grafts applied.

January 8, 1930, Thiersch grafts applied.

Most grafts "took" well and wound was all healed by February 10th, 1930.

From one of our cases (H. S.) the culture grown in brain broth produced two organisms, a short streptococcus growing occa-

sionally as a diplococcus, and a diphtheroid bacillus. These were difficult to separate and we never succeeded in getting them

FIG. 6. Gangrene produced by reinfection of mixed culture twenty-one days after original inoculation.

separated in pure culture; however, unless grown as anaerobes the streptococcus had a tendency to overgrow and mask the diphtheroid.

The following protocols of three rabbits illustrate the different types of reaction to injections of these organisms.

Rabbit 1. May 6, 1930. Two hundred cubic centimeters mixed broth culture subcutaneously. No apparent change at site of inoculation four days later.

May 10, 1930. Five cubic centimeters mixed culture inoculated at the same site. Two days later a small nodule was felt at the site of inoculation.

May 13, 1930. Ten cubic centimeters mixed culture at same site. The nodule noted here persisted for four days when (May 17, 1930) 12 c.c. of mixed culture were administered at the original site. There was marked inflammatory reaction and the skin was thickened and tough.

May 18, 1930. Rabbit died of sepsis.

This series of very large doses repeated every four days produced no gangrene, but the animal finally succumbed to general infection.

Rabbit 2. May 6, 1930. Two cubic centimeters of mixed culture subcutaneously. During the next two days there was no apparent change.

May 8, 1930. Seven cubic centimeters of mixed culture subcutaneously at *a new site* of inoculation.

May 9, 1930. No apparent change in either area.

May 10, 1930. Swelling and redness at second site of inoculation. Five cubic centimeters of mixed culture subcutaneously, at a new site.

May 12, 1930. Swelling and redness at the second and third sites, more marked at the second site.

May 13, 1930. Condition of the second and third sites is improved; ten cubic centimeters of mixed culture are given in a new site subcutaneously.

May 14, 1930. No marked reaction at any of the sites of inoculation.

May 22, 1930. The abscesses have been formed which did not break down and gradually organized.

May 27, 1930. Fifteen cubic centimeters mixed culture in new site. The swellings and thickenings from previous injections still present, but no gangrene developed at any time.

Rabbit 3. May 6, 1930. Two cubic centimeters mixed culture subcutaneously. No apparent local reaction.

Twenty-one days later, May 27, 1930, 15 c.c. mixed culture injected at original site. Two days later an open ulcer with the typical undermining gangrene appeared (Fig. 6).

The cases of gangrene of this type so far reported clinically as well as the case of tissue hypersensitiveness reported by Gatewood and Baldridge[4] and the rabbit experiments here outlined, make it appear likely that the gangrene is an example of the so-called Arthus phenomenon.

Arthus[5] noted that animals receiving repeated injections of horse serum were affected by these areas of cutaneous gangrene. This work was followed by publications by Lewis, Otto, Hooker, Park, and Stewart,[4] whose experiments showed that under proper conditions repeated injections of foreign protein were likely to lead to severe local tissue destruction.

The rabbit protocols selected for illustration of our experimental work seem to support this idea. The organisms in themselves were of very low grade virulence and only produced results in huge doses. Large injections *frequently* repeated were well resisted, but reinjection after a sensitization interval produced characteristic gangrene.

TREATMENT

The treatment of this spreading gangrene of the skin, mostly following draining wounds, should be based first on early recognition of the process. The diagnosis and treatment should be especially referred to the process undermining the skin.

Second, all treatment with antiseptic solutions, Dakin's solution, etc., is not dependable. Treatment with x-ray and different light treatments have not given uniformly good results. In some instances it is mentioned that the process "burns itself out"; but this happens only after weeks and months of suffering, and it is to be remembered that lately at least 2 fatal cases have been reported, and it is most likely that generally the fatal results do not get into print. The reports of Shipley and Alexander, and our own cases are proof that the rational method consists in cutting around the undermined edges, best with an electrocautery knife, excising in this way the whole serpiginous edge of the process, about 1 to 2 cm. from the undermined area (Fig. 5). It is not necessary to cauterize the middle of the defect where the process has stopped, but the progressive gangrene of the skin should be excised. The pain usually stops immediately after this, and the wound can be covered with vaseline or any moist dressing, and the defect can be skin-grafted after a week. This process shortens the time of healing to as many weeks as it formerly consumed months and perhaps years.

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FACTORS IN THE TREATMENT OF
POSTOPERATIVE AND INOPERABLE TUBERCULOSIS OF THE GENITOURINARY TRACT*

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IN the treatment of postoperative and inoperable tuberculosis of the genitourinary tract there are considerations which apply in a general manner to this class of patients. These are only applicable within wide limits and are subject to exceptions in individual patients. The wide variability of the manifestations of tuberculosis in the genitourinary tract necessarily imposes limitations on general statements. Yet it is upon factors of this character that satisfactory results from treatment often depend.

Primarily it is important that patients unless they are hopelessly ill, be advised of the nature of their disease. They should be informed that they have tuberculosis which has invaded the genitourinary tract. It is generally a shock to learn the cause of the illness but composure is soon regained and they are then more earnest and conscientious in carrying on their treatment. For only through comprehending the cause and the nature of the disease will the need be seen for the long painstaking course of necessary treatment. It is unfortunate when only a suggestion of the real condition is given for it often leaves a feeling of carelessness to treatment. The good results which so frequently follow the surgical treatment of genitourinary tuberculosis encourage giving patients full information regarding the nature of the illness.

It is an equally important factor that the plan of treatment be outlined and described when treatment is begun. At the present time it is generally accepted that the treatment should consist of surgery, when it is feasible, and after the surgical care a long course of hygienic and anti-tuberculosis care adapted to the patient's needs. A clear understanding that both surgical and postsurgical treatment, which may have to be continued for a long time, is important in the plan of care and will frequently prevent later misunderstandings.

Patients occasionally are seen who have become discouraged with their progress elsewhere, through misunderstandings of this sort. They had assumed that when they were operated upon their trouble would be cured and the symptoms would immediately disappear. But this had not occurred and after the operation the frequency of urination, burning and other bladder symptoms still persisted. Or another tuberculosis lesion had developed in another site in the genitourinary tract. As a result they had lost confidence and become distrustful of obtaining relief. Many of them did not understand their present state and they had discontinued their former treatment. An outline of the plan of treatment, before the surgical care, describing the necessity of the postsurgical treatment might have prevented the misunderstanding. It not only serves no useful purpose but it often tends to jeopardize the outcome when patients are not aware of what treatment entails.

It has been found to be a practical plan to explain that the treatment of their illness is divided in two parts, the surgical and postsurgical. The object of the surgery is to remove the active focus of the disease insofar as it may be accomplished. The after care is to heal whatever postoperative sinuses remain, to palliate and to attempt to relieve the symptoms; then to fit to the patient a regimen that will have for its object the building up of the general health thus attempting to arrest any lesions which remain and to help prevent further development of the disease. The inoperable patients are treated by a similar

regimen of medical care. It is important to emphasize that the routine must extend over a long period of time and that there are remissions and exacerbations of the symptoms.

The question of where and how best to carry on the postoperative and inoperable treatment comes up for decision at the outset with each patient. There are numerous points to consider. If the disease is very extensive and the outlook discouraging it is probably best for the patient to remain at home. For others with more hopeful prognoses the question arises of whether to go to a health resort, to farms or boarding houses in the country, to a tuberculosis sanatorium or to remain at home.

To go away to one of the health resorts for tuberculosis is usually a question of finances. Considerable money is required to stay at such resorts and to receive competent medical attention for the length of time that is usually necessary to benefit the patient. The number who have sufficient means is apparently not large. To encourage the others in this course often means adding financial worries to their physical troubles.

To go to the farms and boarding houses in the country, remote from specialized medical care, is frequently of doubtful value. The tendency is to drift away from the program of urological and anti-tuberculosis care, when alone and away from medical oversight and contact.

Tuberculosis sanatorium treatment has been rather unsatisfactory in our experience when there are no active lung lesions and the disease is localized in the genitourinary tract. The public sanatoria are mostly all conducted for patients ill with tuberculosis of the lungs and there are no seperate provisions for those with urologic tuberculosis. As a result they are placed with pulmonary tuberculosis patients which many resent and refuse to accept. Sanatorium treatment in an institution especially constructed, equipped and manned for urologic tuberculosis would seem to be an ideal method but unfortunately there are no institutions of that type.

Concerning home treatment it is obvious that treatment is usually begun at home regardless of whether patients go away to health resorts, to the country or sanatoria. And since many do not stay at these places until entirely cured it must be resumed after their return.

Probably the chief reason that treatment must be carried on mainly at home is that it is least expensive. The expenses incurred before and during the diagnosis of the disease, also the costs of hospital care and of the surgical procedures in the operable patients have often depleted their resources. Moreover since the illness is of a chronic nature and treatment must be long continued there is a natural desire to be economical.

Most people have little inclination to go away from home when ill if it can be avoided. They are reluctant about entering tuberculosis sanatoria for treatment. They dislike to break up home ties and to remove for long periods to new surroundings away from their occupation or business. Many, particularly the postoperative patients, can return at least part-time to their work after treatment has been carried on for a time. Removal to a different climate seems to be losing much of its former attraction since it is becoming known that there is no climate which is helpful for all tuberculosis patients. The disease is being successfully treated in practically all climates.

A disadvantage of home care is the lack of control of the patient's routine from the standpoint of rest, fresh air and diet as contrasted with sanatorium treatment. Also the distractions of the home are a drawback, particularly the activities of the other healthy members of the family.

Home care allied with that of a clinic established solely for the study and treatment of postoperative and inoperable urologic tuberculosis, seems to work out fairly well in our experience. Practically all of our patients are ambulant, since active pulmonary cases are transferred to sanatoria, and can make regular visits to the clinic. Four clinic sessions are held weekly and are so arranged that it is

TABLE I

POSTOPERATIVE UROLOGIC TUBERCULOSIS

Case No.	Sex	Age	Operation	Duration of Treatment (Months)	Pulmonary Lesions	Results of Treatment	Able to Work
288987	F.	23	Nephrectomy	6	Arrested	Improved	Yes
281063	F.	54	Nephrectomy	24	None	Improved	Yes
269521	F.	22	Nephrectomy	22	None	Improved	Part-time
266527	M.	42	Nephrectomy	7	None	Improved	Yes
241757	F.	50	Nephrectomy	3	Arrested	Stationary	Yes
280285	F.	24	Nephrectomy	27	None	Improved	Yes
275988	F.	58	Nephrectomy	8	None	Improved	Yes
273288	M.	24	Nephrectomy	16	Arrested	Improved	Yes
150984	M.	48	Nephrectomy	33	None	Stationary	Yes
283065	F.	21	Nephrectomy	4	Arrested	Improved	Yes
265973	F.	18	Nephrectomy	6	Arrested	Retrograding	No
132472	M.	23	Nephrectomy	16	None	Improved	Yes
274641	M.	34	Nephrectomy	32	Arrested	Improved	Yes
278193	M.	50	Nephrectomy	7	None	Improved	Yes
138435	F.	46	Nephrectomy	30	None	Improved	Yes
122768	F.	42	Nephrectomy	33	Arrested	Stationary	No
260143	F.	37	Nephrectomy	28	None	Improved	Yes
289607	M.	33	Nephrectomy	5	None	Improved	Part-time
288081	F.	39	Nephrectomy	8	None	Improved	Part-time
274018	F.	50	Nephrectomy	3	None	Improved	No
257480	F.	46	Nephrectomy	19	None	Improved	Yes
250689	M.	27	Nephrectomy	15	None	Improved	Yes
289043	F.	17	Nephrectomy	7	None	Improved	Yes
269406	F.	33	Nephrectomy	31	None	Improved	Yes
271706	M.	40	Nephrectomy	22	None	Retrograding	No
116865	F.	45	Nephrectomy	36	None	Improved	Yes
279013	M.	48	Nephrectomy	24	None	Improved	Yes
274163	M.	28	Nephrectomy	4	None	Improved	Yes
269083	M.	34	Nephrectomy	12	None	Improved	Yes
150983	F.	43	Nephrectomy	24	None	Improved	Yes
290485	M.	35	Nephrectomy	5	None	Stationary	Part-time
282046	F.	27	Nephrectomy	22	None	Improved	Yes
268306	M.	41	Nephrectomy and (Epididymectomy)	7	Arrested	Retrograding	No
257277	M.	36	Nephrectomy	18	None	Retrograding	No
288047	M.	33	Epididymectomy	9	None	Improved	Yes
250985	M.	13	Epididymectomy	5	Arrested	Improved	Yes
277248	M.	61	Epididymectomy	5	None	Improved	Yes
280406	M.	21	Epididymectomy	18	None	Improved	Yes
279494	M.	26	Epididymectomy	5	None	Improved	Yes
291789	M.	50	Epididymectomy	3	Arrested	Improved	Yes
26~216	M.	28	Epididymectomy and (Seminal Vesiculectomy)	10	Arrested	Died	

Total number treated 41
Died 1
Retrograding 4
Stationary 4
Improved 32

Arrested pulmonary lesions....................... 11
No pulmonary lesion found........................ 30
Able to work.................................... 30
Able to work part-time........................... 4
Unable to work................................... 7

convenient for patients to attend who are working. This grouping or class method of care brings together people with similar ailments which tends to engender better morale and confidence. It makes possible the development of special procedures and it affords an opportunity to study the value of therapeutic measures. Also there is a very real advantage in carrying on the treatment in the urological department of a hospital where there are ample facilities and equipment for urological care.

Tables I and II show the kinds of patients treated in our clinic and the results. Only

TABLE II
INOPERABLE UROLOGIC TUBERCULOSIS

Case No.	Sex	Age	Lesion	Duration of Treatment	Pulmonary Lesions	Results of Treatment	Able to Work
				(Months)			
288973	M.	39	Bilateral renal	19	None	Retrograding	No
166571	F.	41	Bilateral renal	9	None	Improved	Part-time
278631	F.	57	Bilateral renal	13	Arrested	Improved	Part-time
289604	M.	50	Bilateral renal	5	None	Retrograding	No
286032	F.	26	Bilateral renal	22	Arrested	Improved	No
160841	M.	22	Bilateral renal	8	Arrested	Stationary	Yes
173691	F.	27	Bilateral renal	5	None	Stationary	No
169078	F.	22	Bilateral renal	9	None	Stationary	No
280486	M.	17	Bilateral renal	22	None	Stationary	No
133143	M.	32	Bilateral renal	24	None	Stationary	Part-time
180496	M.	34	Bilateral renal	9	Arrested	Improved	Yes
165071	M.	30	Bilateral renal	7	None	Stationary	Yes
174263	M.	17	Bilateral renal	16	None	Stationary	Yes
182467	M.	26	Bilateral renal	8	None	Retrograding	No
164125	M.	35	Bilateral renal (also Tuberculous vesicles)	5	None	Retrograding	No
130154	F.	28	Bilateral renal	48	None	Retrograding	No
272576	M.	20	Bilateral renal (also Tuberculous Spine)	18	Arrested	Stationary	Part-time
157904	M.	38	Bilateral renal	24	None	Improved	Yes
286982	M.	18	Bilateral renal	14	None	Improved	Yes
186642	M.	17	Bilateral renal	4	None	Stationary	Yes
144698	M.	24	Bilateral renal	4	None	Improved	Yes
151037	F.	52	Unilateral renal (Refused operation)	30	None	Improved	Yes
154841	M.	27	Tuberculous prostate and vesicles	21	None	Stationary	Part-time
175068	M.	22	Tuberculous prostate and Epididymes	4	Arrested	Improved	Yes
138439	M.	37	T. B. Vesicles and Testicle	13	None	Improved	Yes
133934	M.	32	T. B. Testicles	36	Arrested	Retrograding	No
133107	M.	40	T. B. Testicles	6	Arrested	Retrograding	No
166077	M.	43	T. B. Testicles	12	None	Improved	Yes
133083	M.	27	T. B. Testicles	4	Arrested	Improved	Yes
159687	M.	48	T. B. Testicles (also Epididymes)	7	None	Stationary	Yes

Total number treated.......................... 30

Retrograding............................... 7

Stationary................................ 11

Improved.................................. 12

Arrested pulmonary lesions................... 9

No pulmonary lesion found..................... 21

Able to work................................. 14

Able to work part-time......................... 5

Unable to work............................... 11

those under treatment three months or longer were tabulated. The total of both groups is 71. Of these one died, 11 seem to be retrograding, 15 seem stationary and 47 seem to be improved. The best results occurred in the postoperative patients who constitute the largest number. There are 20 with evidence in the lungs which seemed indicative of arrested or inactive pulmonary lesions. Some gave histories of previous illness with active lung trouble. In the others the signs seemed

sufficient to warrant the presumption of arrested or inactive lesions. There are 26 females and 45 males. The ages vary from thirteen to sixty-one years and the average age is thirty-four. The duration of treatment varys from three to forty-eight months and the average is fourteen months. Forty-four are able to work at their usual occupations, 9 work part-time and 18 are unable to work. Many of those able to work are undoubtedly hampered more or less by their symptoms.

In regards to treatment it is essential to bear in mind that the disease has not only a local but a general bodily effect as well. To determine what the regimen of care should be it is necessary to consider the data elicited in arriving at the diagnosis, the surgical, pathological or other laboratory findings and the present local and general symptoms. With the knowledge thus gained of the patient a program may be built up to fit the individual needs.

It is difficult to describe concisely treatment of this kind but it seems in our work to fall logically along two lines, the urological and the tuberculosis. The urological care varies widely with the many different aspects of the disease in the genitourinary tract. Briefly, it includes local urethral, bladder, ureteral and renal treatments, when these are indicated, additional operative surgical procedures as the need may arise and occasionally adjuvant operations such as light fulgurations of sluggish bladder ulcers. The tuberculosis care consists of the traditional treatment of the disease, rest, fresh air and proper diet, to which are added quartz light, tuberculin and medicinal therapy.

One should not overlook that it is the combination of these various elements which yields the best results. A part or parts of this basic program should not be selected and treatment limited to it. For example, it is a mistake to assume that urinary tuberculosis can always be successfully treated by vigorous local bladder treatment along with instructions to eat plenty of eggs and milk. No single element of the treatment has yet received sufficient indorsement to warrant its exclusive use.

There is another factor relating to this class of patients as a whole which is rather difficult to define. A considerable measure of the success of the treatment depends upon the physician who carries it on. His attitude to the monotony of the long course of treatment and his ability to gain the confidence and to inspire the patient to continue when conditions are at times going adversely will have much influence on the final outcome. The regimen is largely a method of living and it is his function to impart the rudiments of what the patient must learn. If he has a warm sympathy for urologic tuberculosis patients especially those with distressing symptoms which seem unyielding to treatment and if he can be patient with them in their hopes and in their times of discouragement and in the periods of latency and activity of their symptoms, he will render them real service.

It has been said that no physician could possibly be the possessor of all the qualities that are necessary adequately to treat tuberculosis. It is probably all the more true of urologic tuberculosis which involves both the field of urology and that of tuberculosis. The care of patients of this kind is administered best when there is coöperation between the urologist and the physician who treats tuberculosis.

Dr. L. T. Le Wald: I should just like to say a word in regard to the association of pulmonary tuberculosis with tuberculosis of the urinary tract. I would call attention to the mistake of over-reading x-ray films of the chest, and reading into them an active tuberculosis when there is nothing more there than the old healed childhood tuberculosis with a few shadows of calcified glands. I have just been going over several thousand films of Board of Health cases for admission to Tuberculosis Sanitoria and I was amazed to find there was an over-diagnosis of supposed active tuberculosis in cases which have been proved to be *healed childhood lesions.* I think we must be very cautious in making a diagnosis of a case which we suspect is tuberculosis of the kidney as confirmed by an over-enthusiastic diagnosis of chest tuberculosis, when based on shadows which all of us have in our own chests. In other words, the diagnosis of tuberculosis of the urinary tract should be based upon the local findings, and x-ray and laboratory evidence *as related to the urinary tract itself.*

BRONCHIECTASIS: DIAGNOSIS AND TREATMENT*

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BRONCHIECTASIS is a condition or disease often mistaken for chronic bronchitis, and such a diagnosis is made by the general practitioner and treated with many types of medication from pills to ointments for years without any relief. Each so-called case of chronic bronchitis has a definite etiology and in order to obtain relief one must search for the important underlying cause. When a bronchitic cough lasts more than three months, it should not be treated with medication but bacteriological and x-ray examination should be resorted to, including an examination of the nasopharynx and nasal accessory sinuses, because close inquiry will show many of these patients virtually blowing their noses into the pharynx which produces a descending infection of the larynx and trachea. Shortly afterward the patient develops a cough with expectoration.

Many cases of bronchiectasis are also wrongly diagnosed as acute pulmonary tuberculosis.

Bronchiectasis is an infection in a pathological dilatation in the bronchial segment and occurs partly as the result of an increased pressure on the bronchial wall and partly as the result of a change in the texture of the bronchial wall, including the surrounding lung tissue. The disease causes degeneration of the muscular fibers, which is followed by loss of elasticity and tonicity whence the dilatation occurs. The dilatation itself is caused mostly by the loss of elasticity and tonicity but also by other factors such as increased pressure caused by cough and strain; accumulation of material in the cavity, and constant traction by the normal parts of the lung increased on inspiration. All these play important parts. This disease is not only found in adults but in children as well, usually following measles, influenza, whooping cough and various forms of bronchitis.

Bronchiectasis may be unilateral or bilateral, localized or diffuse, cylindric, saccular or fusiform. It affects the lower lobe only as a rule and the left more frequently than the right. The disease may be congenital or acquired.

Symptoms:
Chronic cough
Purulent expectoration
Weakness
Loss of weight
Fever
Clubbing of fingers
Night sweats
Physical signs
Rales localized chiefly to the base
Slight dullness
Amphoric breathing at times

The main symptoms are a chronic cough and purulent expectoration which at times is quite offensive, occurring most commonly in the mornings on arising. This is accounted for by the change in position as the cavities are at this time full and in turn cause dislodgment of the accumulated pus or material which excites coughing and expectoration.

At times, especially when the disease is advanced, blood is found in the sputum, and again acute exacerbation may come on, characterized by weakness, loss of weight, night sweats and fever. This is the dangerous time, as at this time a wrong diagnosis of acute pulmonary tuberculosis may be made. The clubbing of the fingers and toes is a late sign.

The physical signs are usually soft râles chiefly over the base; if the lung is indurated they are higher pitched and crackling. If a large dilatation is present the percussion note is dull while the cavity is filled, but when secretion is expelled and the cavity fills with air, the note becomes tympanitic.

Diagnosis: Diagnosis is not as a rule a matter of any great difficulty. It depends

mostly on the expectoration of a large quantity of offensive putrid material, the greater part of which is pus, or the cough and physical signs.

Roentgenography: The most valuable aid to diagnosis is the injection of an iodized oil. At this clinic lipiodol is used. It contains 40 per cent of iodine, is obtained from poppy seed and is a stable vegetable oil. The fixed combination of the iodine with the fat renders it non-irritating, and is therefore tolerated by the mucous membrane of the respiratory tract as very little iodine is absorbed from this source. The oil is eliminated from the bronchial tree largely by cough and expectoration. Occasionally a great amount of oil is swallowed. If so, gastric lavage should be resorted to at once followed by a dose of castor oil because the iodine content is readily absorbed in the stomach mucosa. There are four methods employed in the injection of oil:

A. Supraglottic   C. Subglottic
B. Transglottic   D. Bronchoscopic

A. Supraglottic consists of allowing the warmed oil to flow through the glottis into the trachea.

B. Transglottic consists in introducing a flexible rubber catheter through the larynx and injecting the warmed oil.

C. Subglottic consists of passing a hollow curved needle through the cricothyroid membrane into the lumen of the trachea after first anesthetizing the skin and soft tissues. This method is employed mostly by the French.

D. Bronchoscopic. This method, I believe, is the most advantageous and is the one employed by myself. The bronchoscopic method allows the secretion present to be evacuated and, if the disease is bilateral, the oil may be placed on both sides equally well. Again, should any acute infection exist along the bronchial tree the endoscopy would detect it at once. For these reasons I believe this is the most useful of the four methods. The technic of the bronchoscopic method is as follows:

the mucous membrane of the posterior pharynx is anesthetized with 10 per cent cocaine. The patient is placed in a partial upright position and instructed to breathe during the entire procedure. Then the laryngoscope and bronchoscope are passed. As the bronchoscope is placed in the upper trachea a small sponge saturated with 5 per cent cocaine is passed through the bronchoscope and the lining membrane of the trachea partially anesthetized. The bronchoscope is passed to the carina. If the left lower lobe is involved the bronchoscope is passed into the lower bronchus. Aspiration is carried out and should the condition be bilateral the same procedure is carried out on that side. After the secretion is removed, the warmed oil, 20 c.c., is passed from a large glass piston syringe through an aspirating tube. When a unilateral condition exists the entire amount is placed in at the same time; when there is a bilateral involvement, 10 c.c. are placed in each lower bronchus. Thus the bronchoscopic method allows another helpful procedure as equalization of oil can thus be had. The bronchoscope is now withdrawn following the injection of oil and the patient is taken to the x-ray rooms. The oil outlines with precision the size of the cavity formation.

The iodized oil also has a therapeutic effect in bronchiectasis, such as:

a. Lessening the amount of expectoration,

b. Reducing the number of bacteria in the sputum,

c. Lessening the toxic symptoms,

d. Reducing the size of the dilatation.

There are several contraindications for the injection of iodized oil:

a. Acute active tuberculosis,

b. Extensive advanced general pulmonary suppuration,

c. Angina pectoris,

d. Aneurysm,

e. Hemoptysis,

f. Cardiac decompensation,

g. Acute inflammatory involvement of upper respiratory tract.

In cases where tuberculosis is also suspected we use bromipin, which prevents fibrosis from occurring and is harmless to the lesion.

Treatment: First remove the definite etiological factor whether it be an infection or foreign body. Bronchoscopic aspiration should be carried out in each case, following the removal of the cause, as the majority of cases are only partially improved when the etiological factor alone is removed, which means that the patient will have symptoms for months or years thereafter. The benefit of this procedure is obtained by the aspiration of pus from the bronchi, followed by the injection of a medicated oil that acts as an antiseptic in the dilated air cells.

Technic: A laxative is given the preceding night with absence of food for six hours before the treatment. The patient is allowed to rest and one hour before, morphine sulphate, grain ⅙, is given hypodermically. When the patient arrives in the operating room his throat is anesthetized with 10 per cent cocaine solution which is followed in six minutes by placing the patient in position and passing the laryngoscope and bronchoscope. Aspiration is carried out by the aid of a small caliber aspirator with from 3 to 5 lb. of pressure. The aspirator is passed through the bronchoscope to the lower bronchi on either one or both sides. When the material is removed 10 c.c. of a solution containing:

Monochloraphenol	grains	IX	9
Camphor	grains	V	5
Oil of geranium	gtts.	II	2
Olive oil	oz.	I	1

are injected through a clean aspirator attached to a 20 c.c. Luer syringe. The bronchoscopes are withdrawn and the patient is allowed to cough. This scatters the oil into the small cavities and air cells, some being coughed up. Many patients will bring up particles of oil for from twenty-four to forty-eight hours.

This procedure is carried out at weekly intervals until complete relief of symptoms is obtained. In skilled hands the discomfort induced by this method is very slight as the patient starts for home about a half hour after the treatment.

Postural Treatment: This is second in importance on account of allowing drainage constantly. The foot of the bed should be elevated 18 in. whether the patient be in bed eight or twenty-four hours of the day. In conjunction with this, the patient should be instructed to lie over the side of the bed, so that the body is at right angles with the lower extremities for a period of ten minutes three times a day. I had one case where the patient became short of breath and cyanosed about three to five times a day. In this case immediate relief was obtained by placing the patient in the position mentioned before; that is, over the side of bed. This was followed by the coughing out of from ½ to 2 oz. of pus from the bronchial tree.

Medical Treatment: Medical treatment is used to empty the dilated tubes. Ammonium chloride which thins the secretion is used for making expectoration easier. Monochloraphenol solution, 2 per cent, in an atomizer for spraying of throat relieves the upper respiratory irritation. Tincture of benzoin inhalation also helps the lower bronchial tree irritation.

Surgical Treatment: Surgical treatments, such as thoracoplasty, lobectomy, cauterization, artificial pneumothorax and others, should only be used after all other methods have failed.

CONCLUSIONS

1. Remove the etiological factor; secondly, treat the disease.

2. By the use of iodized oil bronchiectasis can be precisely and harmlessly diagnosed. The oil also has a beneficial effect on the condition.

3. Bronchoscopic aspiration and postural treatment are important for a cure.

4. No major surgical procedure should be done unless all other means have been tried without success.

[For Bibliography see p. 80.]

A RESUME ON PROSTATISM*

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THE harmful misconception among the laity and the unwarranted attitude of pessimism prevalent in the minds of many medical practitioners when an old patient presents himself with classical symptoms of prostatic disease, urge me to review the subject in the hope that it may serve to correct such unfounded beliefs.

It has been estimated by dependable observers that 60 per cent of all men who have entered upon the last epoch of life possess abnormal prostates, particularly of the hypertrophic type, greatly enlarged prostate gland, or the atrophic "small contracted scar tissue type," hence the nomenclature prostatism. Therefore, when a man who has attained the age of fifty years or over, of apparent good health, observes that the urinary stream has diminished and consumes more time during the reflex and urinates more frequently and particularly during the night, the suspicion of prostatism is well founded. A slight burning sensation usually accompanies urination (initial stage). Catheterization of such an individual discloses the fact that the urinary bladder has not emptied completely. What has not been voided is known as residual urine. In the beginning the quantity is small (stage of incomplete retention), but with the years there is an augmentation of these symptoms until micturition becomes a dreaded ordeal and the quantity of urine voided is practically nil (stage of complete retention).

By practicing digital exploration of the gland one notes that it is either greatly enlarged or of the atrophic sclerotic type. One must also remember that in some cases the enlargement may be intravesical which is demonstrated only by a cystoscopic examination. The digital examination therefore is confirmatory only, never absolute.

In a certain number of cases the initial symptom may be an accidental acute complete urinary retention in the interim of apparent good health. This type of retention may not reappear for years after being relieved. In other cases it may assume the intermittent character particularly if the individual is prone to irregular habits. In the majority of cases, however, the disease progresses slowly and with it many complications follow that undermine the patient's vital powers.

The following are the usual complications: cystitis, pyelonephritis, renal sclerosis, urosepsis local or general, prostatic hemorrhage, prostatic abscess, debility of vital organs as a result of the constant presence of pus organisms.

Under the aspect of surgical treatment, the complete removal of the obstructing gland must be considered as the ideal cure. We are indebted indeed to Squier of New York under whom I had the privilege and pleasure of studying the progress made in this surgical field, i.e., transvesical prostatectomy. At the present time this procedure has a mortality of 5 per cent.

In every surgical case the attending surgeon must decide his modus operandi according to the degree of disturbance. Cardiac pulmonary blood and renal function tests are to be utilized. At the present time there is no need to treat these prostatics hurriedly and blindly.

If the creatinine and blood urea particularly are in excess and do not become better after preliminary catheterism, the patient should not be operated on. On the other hand, should the investigation prove scientifically conclusive, then surgical intervention is justified.

RELATION OF THE ROENTGEN WAVE LENGTH
TO THE BIOLOGICAL EFFECT*

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IN the field of roentgen rays, recent years have brought forth some interesting studies, in the effort to solve the problem of the biological effectiveness of roentgen irradiation as regards the quality of the rays used. The school of Holthusen[1] has devoted special attention to the solution of this problem. Holthusen himself has taken up the subject and comes to the conclusion, that an influence on the course of the mortality curve for Ascaris ova cannot be determined by a varying quality of the rays. Determann[2] (together with Jacobi and Holthusen) arrived at the same conclusion in an older publication. The studies of the school of Holthusen go back as far as Volumes 26 and 27 of *Strahlentherapie* and the studies appearing in these volumes on the erythema formations in the human skin have arrived at about the same result.

But inasmuch as, on the one hand, a great many authors arrive at the conclusion of the independence of the biological effect from the quality of the rays, and, on the other hand, a number of prominent radiologists have obtained contrary results, we, in this article, shall attempt to correlate the most important publications of this nature and their partially varying results. Naturally, we will not cover all of these studies, but will rather limit ourselves to the studies which are apparently the most important, the conditions of their experiments, and their conclusions.

In an abstract on the occasion of the Second International Roentgen Congress we have expressed our opinions on the work of Hess[3] and Determann.[2] Now we shall briefly discuss their work. The following Tables (I and II) were compiled from the studies of these authors. If one presents the results of Table I graphically, according to the applied dose depending upon the primary quality of the rays, which we characterize as the so-called half-value layer of copper according to the proposal of Holthusen, one distinctly sees, that even with the observation material of Hess there is a definite dependence upon the quality of the rays. In Figure I we present the results graphically.

TABLE I

ACCORDING TO HESS

Tension and Filter	Half-value Layer of Copper	R-number of Primary Radiation for Fields		
		1.5 by 1.5	6 by 8	15 by 15
185 kv. 1 Cu 1 Al	1.32 (1.39)	680	540	485
180 kv. 0.5 1.0 Al	....	720	575	515
145 kv. 2.0 Al	0.28	710	590	548
110 kv. 2.0 Al	0.15	690	575	530
110 kv. 1.0 Al	....	700	580	540
60 kv. 0.5 Al	0.08	750	680	625
60 kv.		750	680	625

On the basis of a comparison with the quality values of Table II, we have coördinated the individual primary qualities used by Hess with the half-value layers for copper given in the second column of Table I. Because of the recently reported dosage table of Grebe,[4] we have added the more accurate value for the first irradiation and have added the latter to Figure I.

In the upper curve Figure 1 shows the relationship between applicable roentgen values in R and the half-value layer of the
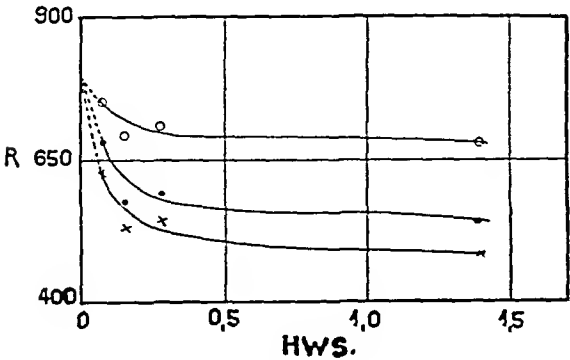

FIG. 1. Graphic presentation of results of Hess from Table 1.

primary radiation for the smallest field of irradiation; the lowermost curve shows the corresponding ratio for the largest field, 15 by 15 sq. cm. *A dependence in favor of the harder rays is very apparent, inasmuch as for the latter a smaller number of the roentgen value in R is necessary to reach the same biological effect.* There is something else that can be read from these curves. It appears that the three curves can be easily continued to 800 R. This indicates, that, practically, with a very soft irradiation, in which the secondary rays can be

neglected both quantitatively and qualitatively, 800 roentgen units must be applied in the three fields of different sizes in order to reach the biological effect of erythema formation.

From the second table of Determann there is then seen from the comparison of the total cases (last column) a strikingly good conformity of the biological effect with the use of different qualities (hard and soft). This result, however, takes on a different aspect when one considers the last horizontal row of this table. Here the periods of irradiation for the different qualities, hard, soft, are compared with each other. This can, naturally, be taken to mean only that the focus-surface distances are varied in such a way, that the intensities impinging against the body surfaces were in accordance with the different qualities. If one excludes the one high value of Glasser, one obtains the ratio of 0.9. *This means that the periods of irradiation for the same irradiation intensities are somewhat shorter for hard rays, which corresponds with Figure 1. A complete reversal obtains, however, when one considers the Glasser value as 4.38. The new medium value is then 1.47, which is very much in favor of the soft radiation.*

TABLE II

ACCORDING TO DETERMANN

Kv.	Filter	Half-value Layer Mm. Cu	Determann		Glasser		Schreuss Schönholz	Klein and Gärtner	Total Cases
64	Carton	0.06	....	....	....	2(2)	....	4(4)	6(6)
64	3.0 Al	0.09	2	....	....	....	....	....	2
85	2.0 Al	0.12	....	4	....	....	....	....	4
130	Carton	0.15	....	....	7(2)	....	....	....	7(2)
110	3.0 Al	0.18	....	....	....	....	2(2)	....	2(2)
160	3.0 Al	0.30	....	....	....	....	2(2)	....	2(2)
130	0.5 Cu 1.0 Al	0.60	....	....	7(2)	2(2)	....	....	9(4)
156	0.8 Cu	0.86	....	4	....	....	....	4(4)	8(4)
186	1.0 Cu 1.0 Al	1.32	2	....	....	...	....	....	2
Hard, more effective than soft........			....	2	....	1(1)	1(1)	3(3)	7(5)
Soft, more effective than hard........			2	....	4(1)	1(1)	....	....	7(2)
Hard and soft, equally effective.....			....	2	3(1)	....	1(1)	1(1)	7(3)
Relation of the radiation periods: Hard: soft...................			1,175	0.887	4.38	1.06	0.44	0.87	

At different times we have called attention to the fact,[5,6] that it is not feasible to use the primary radiations in comparison with the biological effect. The secondary radiations (electronic and wave radiation, insofar as concerns the formation of electronic radiation within a certain volume), which are the biologically effective ones, possess effective energy values, which are considerably less favorable as compared with those of the primary radiations. In addition, they are almost similar, even with the softest and hardest primary radiations employed by the authors mentioned. In Table III we present a compilation of different radiation qualities, namely, first, those of the primary bundle, then of the purely secondary radiation and, finally, of the total radiation, always expressed by the effective wave lengths.

TABLE III

COMPILATION OF DIFFERENT PRIMARY AND SECONDARY QUALITIES

No.	Tension in the Tube (Kv.)	Filter in Mm.	Primary Effective Wave Length in A. Units	Second-ary Efficient Wave Length in A. Units	Total Effective Wave Length in A. Units
1	85	0.5 Al	0.280	.....	0.264
2	124	2.0 Al	0.229	.....	0.212
3	151	4.0 Al	0.206	.....	0.194
4	176	0.5 Cu	0.155	0.179	0.163
5	176	1.0 Cu	0.145	0.176	0.160
6	176	3.0 Cu	0.118	0.174	0.138

In the next to the last column of Table III we have not given any secondary wave lengths for the first three-ray qualities, as the former differ from the primary qualities only slightly. Nevertheless one sees, that the total radiation has a different quality from that of the primary radiation. The hardening of the radiation lies in the filtering effect of the uppermost layers of water, in which the ionization chamber with its relative large surface was placed.

In Table III, irradiation No. 4 shows distinctly that the secondary radiation is far behind that produced by primary radiation as regards its quality. In addition,

one sees that the individual secondary radiation qualities differ among themselves relatively little, whereas the corresponding primary radiations differ considerably from one another.

Under such conditions, can we expect to find any difference in the biological effect? According to our opinion, only when the biological test object is sensitive enough. But inasmuch as we must generally deal with results that can vary 10 per cent from one another, we must not be surprised if there is an apparent independence of the biological effect from the radiation quality. The objection also, that the total radiations of the first three types of rays in Table III as well as secondary radiations, of which the last three qualities are quite different and therefore an effect in the biological effectiveness could be expected, does not appear to us to be valid, as we have already shown on another occasion. In a forthcoming article in *Strahlentherapie* we again show, that only the number of electrons deserves consideration in the calculation of the different qualities. When one considers the different absorbabilities, one finds it is almost the same in the different qualities of Table III. The differences, which actually appear to favor the softer radiations, are within the biological accuracy of the reaction. If one had at his disposal the primary qualities produced as secondary qualities, a distinct difference would probably have come to light. We, therefore, believe that still more penetrating primary radiations than are generally used today are necessary to finally decide this question. That still other investigators hold the same opinion is shown by the fact that various firms that are manufacturing roentgen outfits are beginning to produce apparatus for 400 and more kilovolts.

How about the latest work of Braun and Holthusen in this respect? We distinctly state at this time that we do not in any way wish to minimize the excellent works of the Holthusen school and the other authors cited. We are only concerned with shedding some light on the subject in

question from all sides and to subject all the factors, which are necessary for further development, to criticism.

The authors mentioned extend their experiments to Bucky's grenz rays and ultraviolet rays and conclude that there is no relationship between the biological effect and the wave length.

As compared with the works previously discussed, the field of observation as regards the soft radiations is quite extensive, but naturally this has nothing to do with the deeply penetrating radiations. We have been able to show that a further increase of the quality (see Table III, irradiation No. 6) does not result in any difference in the biological effectiveness on sprouting beans, but we have also mentioned at the same time, that the truly biological effective radiation in its quality was improved very slightly. At any rate a slight systematic change not in favor of the harder radiations was demonstrable, but this does not at first effect the fluctuations in the biological reaction power. In this same work,[5] we also spoke of another effect which, in our opinion, has not been given sufficient consideration up to the present time.

If, for example, one considers a volume of tissue lying immediately under the skin, the biological reaction is produced by the absorbed amount of energy within the volume. This energy is mostly attributable to secondary phenomena, namely, both the electronic radiation and the wave radiation in their reciprocal relationships. If one imagines this assumed volume to be surrounded by an extremely thin, non-absorbing wall, a certain amount of the radiation will escape from the assumed volume, but others will enter into the observed volume from the immediate surroundings.

The energy that is disseminated into the volume is the greater, the greater the primary energy. If one then imagines this volume to be replaced by a small chamber that is unaffected by the wave lengths and measured off into ray units, and if one

treats this chamber within the irradiated tissue alternately with a soft and then a hard radiation, the same number of rays will be measured for both qualities of the rays by the same number of electrons produced in the chamber. In this way there naturally prevails a balance between the energy lost by the early penetration into the chamber wall and that of the electrons brought out of the chamber wall by the photographic effect. This requires the definition of the measuring chamber that is unaffected by wave length on the basis of the radiation unit definition of Behnken. Naturally, the radiation that will escape from such tissue volume cannot take part in the estimation, because this radiation with its assumed equally large chamber in the wall of the same, loses its effectiveness and is absorbed.

But how about the radiation coming from without? This admittedly is composed of an electronic radiation and a secondary wave radiation. The latter will penetrate the chamber wall as well as the extremely thin and non-absorbing wall of the tissue volume, which was assumed before. Naturally, both the material and the thickness of the chamber wall then provide at first uncontrollable conditions, both of which, however, act in the same direction. Inasmuch as a metal (silicium) is added to the carbon chamber so as to annul the effect of the Behnken chamber wall, the entering wave radiation will reach the chamber in a weakened state. The thickness of the chamber acts similarly, so that the presence of a greater energy in the tissue volume must be taken into consideration than is calculated by the measurement.

In addition to the wave radiation there exists also the electronic radiation from the immediate vicinity of the chamber. Of this, nothing reaches the interior of the chamber, because even the most rapid electrons exhaust themselves in the wall. In tissue, therefore, all these electrons, which do not appear in the calculation with the ionization chamber, will be able to exert their influence.

What, then does one measure in the chamber? The same number of electrons with different secondary ray qualities; but with the harder radiations, exclusive of the electrons penetrating into the volume under consideration from without, and in all cases the wave radiation directed, though weakened, from without toward the interior of the volume. This effect is the greater, the more penetrating the primary radiation and also the more energetic the secondary radiation.

The result is, that with hard radiation in the tissue volume observed the same number of electrons is manufactured for the production of the same biological effect as with soft radiation, that the previously mentioned radiation effects are superimposed upon the effects of these electrons, and that in reality a large dosage of effective radiation is applied. From this one must conclude, that so long as the electrons are counted in the calculation of the applied dosage, the harder radiation is the less effective.

This produces no change in the calculation of the primary energy in the reception chamber. Here only the primary qualities and quantities are compared with each other, that are necessary to achieve a certain biological effect certainly with an entirely different quality and quantity. So long as the secondary energies do not differ too much from one another, a comparison of the primary qualities is also possible. But it is doubtful whether the Bucky grenz rays are not too far removed from the softest roentgen radiation as regards the secondary effective wave length. This also applies particularly to the ultraviolet radiation. Even though Braun and Holthusen in their work find no influence on the course of the curve of injury with the use of different radiation qualities, these facts do not definitely lead to the conclusion that hard rays are just as effective as the soft rays. At any rate, the influence of the chamber grenz effect mentioned here and elsewhere must first be confirmed by experiments in order to show that there is a noteworthy effect upon the dosage.

Finally, we would like to raise another question as regards the radiation with ultraviolet light. It is a well known fact that the wave lengths of this field of radiation are absorbed by very thin layers. If the uppermost layers of the Ascaris ova were not or only slightly permeable to ultraviolet light, the question, as to what the actually effective factor is, would be justified. Undoubtedly, the visible light originating in the burner also has an effect upon the ova, and one could imagine a superimposition of several effects.

We would like to call attention to another phenomenon, which may have an influence upon the results of Holthusen in his graded experiments. We refer to the change in the quality of the primary radiations with a varying focus-surface distance. We have found, that when measurements of the quality of the radiations are made according to the method of Duane, as repeatedly described by us, with different focus-surface distances, the quality that reaches the measuring chamber varies. The school of Holthusen has also conducted some measurements of quality, in which an aluminum chamber was placed over the thimble chamber, by means of which the total radiation quality could be determined by two measurements of intensity. For a long time we have used a 1 mm. thick copper chamber and have determined the purely secondary radiation of different primary qualities both quantitatively and qualitatively. For the investigation of the change in quality with distance, we have, for the sake of simplicity, measured the entire bundle of rays once without the copper filter mentioned and once with it. The secondary radiation reaching the chamber from the relatively large volume of water or air, respectively, which lies in the immediate vicinity of the chamber, is not changed by the action of the open beam of light; only the quantity and the quality of the radiation which is reflected upward immediately under the chamber

undergo a change, as altogether a filter of 2 mm. thickness must be permeated by the primary radiation. The portion of the re-
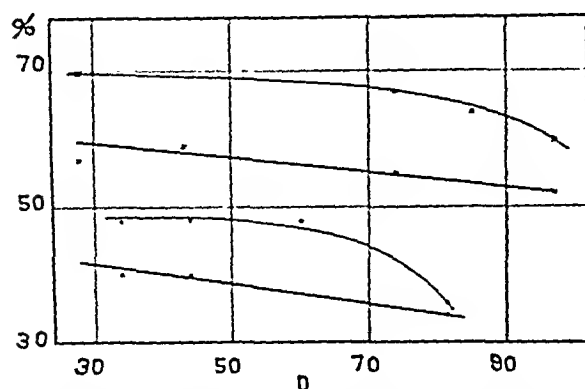

Fig. 2. Relationship between radiation quality and focus-surface distance, with and without influence of water.

flected radiation reaching the chamber from this volume, however, is so slight as compared with the entire reflected radiation, that it has no special significance and, therefore, the results obtained may be considered as nearly correct. At any rate the striking difference of the different qualities cannot be explained by this alone.

The curves in Figure 2 show the differences between the qualities measured in this way. In the measurement with water, the measuring chamber was placed half in the air and half under water. In the measurement without water the chamber remained in the same place.

The following tables show the experimental details and indicate that the primary radiations used were fairly penetrating. It is interesting to observe that without water curves are obtained which, at a distance of about 60 cm., approach a straight-lined course, and that practically at a distance of less than 40 cm. an essential change in the quality is no longer demonstrable.

In the presence of water there is observed an absolutely straight-lined course of the relationship between the quality and focus-surface distance. It appears, however, that even with a distance of 30 cm. a constant quality is not obtained at the surface. We attribute this phenomenon to both a

TABLE IV

MEASUREMENTS OF QUALITY WITH 3 MM. OF COPPER FILTER AT DIFFERENT DISTANCES

Focus-surface Distance, Cm.	Percentages of the Radiation that Still Penetrate 1 Mm. of Copper. The Corresponding Effective Wave Lengths in Parentheses	
	Without Water (A.U.)	With Water (A.U.)
97	60.4 (0.130)	52.3 (0.143)
85	63.8 (0.122)	
74	66.7 (0.118)	54.6 (0.142)
60	68.5 (0.114)	55.0 (0.142)
43	....	58.6 (0.134)
28	69.6 (0.112)	57.0 (0.138)

TABLE V

MEASUREMENTS OF QUALITY WITH 0.5 MM. OF COPPER FILTER AT DIFFERENT DISTANCES

Focus-surface Distance, Cm.	Percentages of Radiations that Still Penetrate 1 Mm. of Copper. The Corresponding Effective Wave Lengths in Parentheses	
	Without Water (A.U.)	With Water (A.U.)
81	36.0 (0.174)	34.0 (0.179)
60	47.5 (0.153)	36.0 (0.175)
43	48.0 (0.153)	40.0 (0.166)
34	48.0 (0.153)	40.0 (0.166)

spreading of the primary radiation into the air and to a spreading to neighboring objects with tubes which are not absolutely closed. The fact that the qualities in the presence of water are generally less than those that are obtained without water is due to the conditions of spreading in the water alone. The main figures in the last two columns of Tables IV and V are percentages of the radiations that can still penetrate through 1 mm. of copper, and the figures in parentheses are the effective wave lengths that are obtained by Duane's curve.

In their work, Holthusen and Braun report that in the graded experiments at different distances from the anticathode the intensities showed a ratio of 1:10 and that the smallest distance was 20 cm. The greatest distance must have been 63 cm. But in addition there is possibly also a change in quality, so that the different

portions of Ascaris ova were irradiated for the same period of time in order to eliminate the influence of the time but yet with different qualities. What are the conditions, in addition, in the graded experiments with the unequal distribution of the intensity prevailing within the field of irradiation?

This work with hard and very soft roentgen rays and rays that reach into the realm of ultraviolet and visible light is in contrast with the work of Packard, who extends his investigations up to the gamma rays of radium emanation and comes to the same conclusion the independence of the biological reaction from the wave length. The same author also contributes another work,[8] in which he reports on experiments with roentgen rays of different wave lengths. The wave lengths selected by him include 0.2, 0.5 and 0.7 Angstrom units, and fall in the realm of radiations for which some authors claim a greater biological effect. In the gamma ray experiments of this same author the radiation reaching the Drosophilla larvae is, in our opinion, not absolutely freed of beta rays. On the contrary, electrons of considerable energy are liberated from the hard rubber, which serves as a partition between the larvae and the emanation apparatus, and from the paper, which serves as a carrier of the larvae, which electrons must reach the larvae in part. We readily admit that just as with the gamma radiation, it is exceedingly difficult to get rid of the influence of the electrons; but this does not prove that there is an independence between the biological effect on the one hand, and the wave length, on the other. If one thinks only of the effect of the total radiation as liberated from that of the beta radiation, some other curve would have to result, or else the relationship of the millicurie-minutes to the roentgen units would have been different from what is shown by the figures of the author. In this respect, also, the direct report of the radiation energy in roentgen units reaching the ova would have been more purposeful.

As already mentioned, there then appears a work[5] by us which takes up the same problem. We have used as our test object the Vicia faba bean, which has also been used successfully by other authors. We readily admit the correctness of the objection of Holthusen, that a bean reveals a large number of different cells in the root, which is the part most sensitive to radiation, and that the desired effect must appear as a medium value in the result. If we except various individuals with a markedly varying reaction, which we have never been able to observe in our experiments, we recognize in this medium value, as is assumed by Holthusen, the very evidence, that different cells react differently to the same quality of radiation.

In our experiments, we have also found a greater sensitiveness in the realm of the soft rays, corresponding with the results of Glocker.[9] We would again like to repeat that the pure secondary radiations of the radiation mixtures employed by us differed very little from one another in their effective wave length. We have also mentioned why this must be the case. We were also able to show mathematically, that an essential difference in the biological effect cannot be expected, just because of the slight difference in the quality of the secondary radiations. If, however, a difference does appear, it may well be assumed that the same will prove to be more pronounced with still greater differences in the quality of the secondary radiations. If we also consider the chamber-grenz effect mentioned previously, we would have to all the more obtain a lesser biological effectiveness in the realm of the hard rays.

All of the experiments reported heretofore, in our opinion, apply only to the test objects used at the time, which showed markedly different sensitiveness to the radiations. In order to obtain the same biological effects very much larger doses are required for Ascaris ova than for beans which, again, are more sensitive than the human skin. It appears important to us that these experiments should be repeated under

absolutely clear physical conditions on as many test objects as possible. Finally, it must not be forgotten, that even with the smallest test objects the primary radiation is disseminated and hence the effective energy is changed. The exact determination of this effective quality is the basis for the determination of the relationship between the radiation quality and the biological effect.

In summary, it may be said that the previously published reports that have endeavored to determine the effectiveness of various radiation qualities in human skin are not sufficiently convincing, as the effective radiation qualities are entirely different from the corresponding primary qualities and also are hardly any different from one another. The reports of different authors (Glasser and many others) on the necessary roentgen units with Bucky grenz rays seem to show the opposite of the school of Holthusen's conclusions.

This applies also to the experiments on Ascaris ova, or Drosiphilla larvae, or sprouting beans, in which secondary radiations that are different from the primary radiations, also come up for consideration. It is still undecided, which are the effective qualities that act upon the sensitive portions of the cell with irradiation with grenz rays and ultraviolet light. The presence of a part of the visible light in the quartz lamp, particularly, provides uncontrollable conditions. The experiments with hard radium rays also do not yet seem to be sufficiently certain because of the effect of the secondary beta rays.

The slight dependence on the quality of the radiation in favor of the soft radiation in small doses determined by Glocker, is confirmed by us in a work published during the same year.

When it is a question of measuring the intensities with a small chamber on the surface of the water, where a definable quality prevails, which is also effective on the small object of the Ascaris ovum, and when these objects are exposed to the corresponding qualities on the surface of the water, a chamber-grenz effect may appear, which admits of a change of the independence found which is not in favor of the hard rays.

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MODIFIED CANNULA FOR URETHRAL INSTILLATION*

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THE instillator, which consists of a syringe to which is attached a hollow sound, is used frequently in

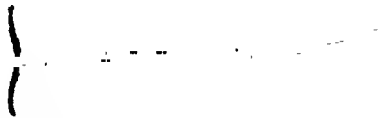FIG. 1. Instillator cannula as manufactured. (Drawn to scale.)

FIG. 2. Suggested modification of cannula. (Drawn to scale.)

the treatment of urethritis. When properly manipulated this sound, or cannula, is inserted into the urethra until its tip is just beyond the cut off muscle and the selected medicament is injected into the posterior urethra. The tip should not be introduced into the prostatic urethra. If so desired a portion of the same medicament may be

anterior urethra must be stretched. This curve is such that the tip hugs the urethral roof so closely that frequently the membranous urethra is entered without the characteristic jump of an instrument passing the cut off muscle, so the operator, forgetting that the pars membranacea is but 1.5 cm. long, is apt to insert the sharp tip well into the prostatic area and thereby invite those complications of urethritis most to be avoided.

It seemed probable that a cannula of this size (13 F.) with a less acute flexure would traverse an inflamed anterior urethra with less trauma and that such relation might be established between the curve and the shaft as would indicate approximately the location of the tip when the instrument is in the urethra. Herewith is presented a modification of the instillator cannula which may be had by anyone who will merely straighten the curve thereof accord-
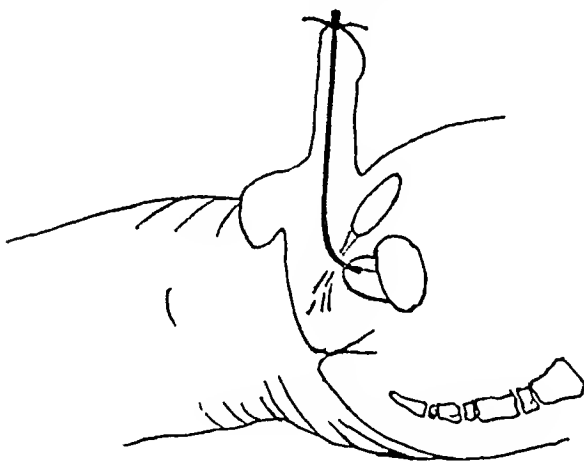
FIG. 3. Cannula as manufactured, showing tip within prostatic area when shaft is vertical and patient supine.
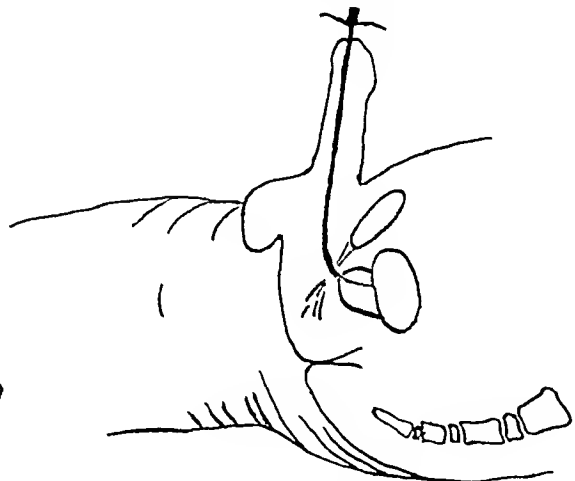
FIG. 4. Modified cannula in position for use, showing tip to be within membranous urethra when shaft is vertical and patient supine.

deposited in the anterior urethra as the instrument is withdrawn.

The cannula most commonly sold is 13 F. in diameter, rather small and too pointed for safety, and has an acute curve over which a (usually) tender and inflamed

ing to the illustrations. Its contour assures quite accurately that with the patient supine and the cannula in situ for use, when the shaft is in a vertical position the tip will have entered and will rest within the membranous urethra.

CALCULI IN ECTOPIC KIDNEY*

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MR. R. entered the Urological Department of the New York Hospital on February 24, 1930, complaining of pain in the right hip and right leg. The family history was irrelevant.

Past History: He has always been well except for a bilateral herniotomy eight years previously. He had another herniotomy for recurrence on the right side one year later. History of venereal disease denied.

Present Illness: Began four months ago with pain in the right leg. Four weeks later the pain spread to the back of the thigh and then to the right hip. This has been continuously present since that time. About one year ago, he had pain on urination lasting three months. Two weeks ago this dysuria recurred but stopped a few days later following cystoscopy.

Physical Examination: Showed a slightly built man who appeared to be fifty-five years of age, fairly well developed, and rather poorly nourished. There were two scars in the right inguinal region and one in the left groin. The splenic dullness appeared to be on the right side and the area of the liver dullness on the left side. The heart was transposed, being on the right side. Otherwise the heart was normal. Blood pressure 114/78. Rectal examination showed the prostate to be enlarged to two and one-half times the usual size, boggy in consistency. Six ounces of residual urine were obtained. Reflexes were normal.

The interior of the bladder showed a moderate amount of edema and congestion, especially in the region of the trigone. The right ureteral orifice was somewhat edematous and enlarged. No. 6 catheter passed to the renal pelvis on each side, without difficulty. Specimens were taken from each side for urea, microscopic and culture. An intravenous phenolsulphonephthalein test for renal function was done. X-rays were taken before and after injection of sodium iodide into the right renal pelvis, patient being in the prone and erect postures, the catheter being withdrawn in the latter position. The specimen from the right kidney showed 17 g. of urea, and that from the left side 21 g. per liter. Phenolsulphonephthalein appeared in five minutes from each kidney and in ten minutes the left kidney excreted 13 per cent and the right, 5 per cent, of the dye.

Results of X-rays: Left kidney shadow was seen to be low in position. The right kidney was ectopic, located on the promontory of the sacrum where there were two shadows, one about the size of one's thumb, and one about the size of the end of one's index finger.

Right Pyelogram: Showed a filling defect at the points where the previously mentioned shadows were noticed. A diagnosis was made of calculi in ectopic kidney and it was suggested that the calculi be removed under regional anesthesia.

Preceding operation, his blood urea nitrogen varied from 8 mg. to 20 mg. His blood sugar was 120. The Wassermann test was negative. His urine showed the presence of a faint trace of albumin and a moderate number of pus cells in the urine. Cultures of the bladder urine showed the presence of B. proteus. Otherwise the urine showed nothing of interest. On February 5, he was operated on under paravertebral anesthesia, 1 per cent novocaine being used.

A golf stick incision was made and extended down to the peritoneum. The original intention was to do an extraperitoneal operation but it was found that there were numerous peritoneal adhesions due to two previous right herniotomies, so that it was decided to do a transperitoneal operation. The parietal peritoneum was incised and the intestines were displaced with gauze packs, exposing the right kidney which was in the region of the promontory of the sacrum.

The stones could be palpated before the posterior layer of the peritoneum was incised.

* Submitted for publication August 2, 1930.

It was thought best not to attempt to remove the kidney, but to do a nephrotomy for removal of the calculi. The incision was then made through the posterior layer of the peritoneum, over the region of the larger of the two calculi. The calculi were easily removed after a little exploration with the index finger. The kidney was not enlarged and was fixed in position very firmly. A few small aberrant blood vessels were noted.

A soft rubber catheter was placed in the nephrotomy incision. Surrounding this catheter six cigarette drains were placed down to the kidney. Following this operation, his temperature was normal for ten days except that on the sixth day postoperative it rose on one occasion to 102°F. He suffered but very little discomfort during this time.

The cigarette drains were removed in one week and the catheter was withdrawn about 1 in. daily, until it was removed on the twelfth day postoperative. On the thirteenth day postoperative, his temperature suddenly rose to 104.6 and from the thirteenth day postoperative to the twenty-sixth day postoperative, he ran a temperature fluctuating from 98 to 105.4°F. Daily variations in temperature were quite marked. No cause for this elevation of temperature was found outside of the urinary tract. The abdomen was moderately distended, and the blood count twenty days postoperative was 20,000. It was decided on the twentieth day postoperative to do an intravenous pyelography. A uroselectan urogram showed fairly well the outline of the left renal pelvis and ureter, but the right side was not visualized. It was decided that the right kidney should be explored in an attempt to remove the cause of the continued fever. This was done on March 18. A left rectus incision was made, the peritoneum opened, the intestines packed off, exposing the region of the ectopic kidney. The kidney felt somewhat fluctuant. A small incision was made in the surface of the kidney but no free pus was obtained although the entire kidney was boggy. A rubber catheter surrounded by five cigarette drains was inserted in the region of the incision. The left kidney was also palpated and nothing abnormal found. The wound was closed and the patient returned to his room in good condition. Following the second operation, the temperature remained considerably elevated for a period of one week, when it became approximately normal.

One week following the second operation, his condition appeared markedly improved, and he began sitting up ten days postoperatively. Four days later he left the hospital in very good condition. Weight before admission to hospital, 111 lb. Weight upon discharge from hospital, 91 lb. Weight at present, 116 lb.
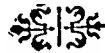
SUBLUXATION OF THE HEAD OF THE FIBULA*

M. S. BURMAN, M.D.

NEW YORK

LYLE, in 1925, collected 41 cases of this simple but uncommon dislocation of the head of the fibula. Three new cases have been recorded in the literature, those of Hall, Hogenhauer and of Lemprière. To these I wish to add another.

Case. E. T., a boy, aged seventeen, referred to me by the Welcome House Settlement, was seen on December 3, 1929, because of the presence of a bony prominence on the outer side of his right knee. While running in a 60 yard dash last June, he thinks he may have twisted the foot or leg. He is definitely not sure of this. He noticed a dull pain and stiffness in the knee the day after the race, and these symptoms lasted a few days. Since then, he has noticed the prominence of the fibular head. At times, he has a certain amount of stiffness in the knee, together with a feeling of insecurity. When pain is present, it is dull and located between the head of the fibula and the tuberosity of the tibia, never in the knee-joint proper. However, he has been able to carry on athletic work.

Examination of the right knee shows an increased prominence of the fibular head, as compared with the normal left side. Motions in the upper tibiofibular joint (always slight) are increased, the leg being used as a long arm lever. Motions of the knee are normal. As the knee moves from full flexion to full extension, the head of the fibula is seen to subluxate forwards and outwards at 90° flexion, and to remain so until 160° extension is reached, when it reduces itself. There is definite and marked tenderness over the head of the fibula, when it is subluxated; none when it is self-reduced. There was no injury to the external popliteal nerve. A roentgenogram of the affected knee was negative.

An elastic knee-cap with a circular belt and buckle arrangement, sewed on, was advised to hold in the head of the fibula. However, the patient refused any treatment.

It is possible that the tearing or stretching of the external joint capsule, while the boy was running, was due to a strong inadvertent, inward rotation of the leg, with inversion of the foot, the knee being extended.

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HYPERTROPHIC PULMONARY OSTEOARTHROPATHY

(BAMBERGER-MARIE DISEASE)

REPORT OF A CASE FOLLOWING INTRATHORACIC MALIGNANCY*

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MARCH 13, 1929, P. Z., an adult male, aged forty-four years, a moulder by trade, was admitted to the Reading Hospital.

HISTORY

The patient was apparently well until nine months ago, when he noticed a small lump on the right side of his neck. Almost immediately he went to his physician, who told him that he needed a tonsillectomy, which was performed. The operation, done at a neighboring hospital, was uneventful except for probably a little more than the average tendency to bleed

from the right side. The patient went back to work but soon noticed that his extremities became swollen. The swelling was first seen

senses. Hearing was good and so was vision. There were no headaches, disturbances of vision or drowsiness.

Fig. 1. Adenocarcinoma, grade iv (× 160).

in the hands and feet but very soon he noticed that his knees and all the joints of his extremities seemed enlarged. There was no pain. He showed his enlarged hands to his boss, who told him that he was not going to live much longer and that he should stop work and go to see his doctor. The swelling in the neck became gradually larger, and as time went on it became slightly tender. His extremities enlarged to the extent that his hands were noticed by every one, and whereas, he used to wear a number eight shoe he now needed a number twelve, and these were too small.

He had had a cough for seven or eight months, which had not given him much annoyance, but recently it seemed to have become more severe. There was no coughing at night. At first, there was no expectoration; however, as time went on there was slight clear mucous expectoration. Work seemed to aggravate the cough.

His appetite was good. No particular type of food disagreed with him. The bowels moved quite regularly.

Urination was normal. The patient did not have to get up at night for anything and slept quite well.

There were no worries except that he was used to work and wanted to go back on the job as soon as he was able.

There was no history referable to the special
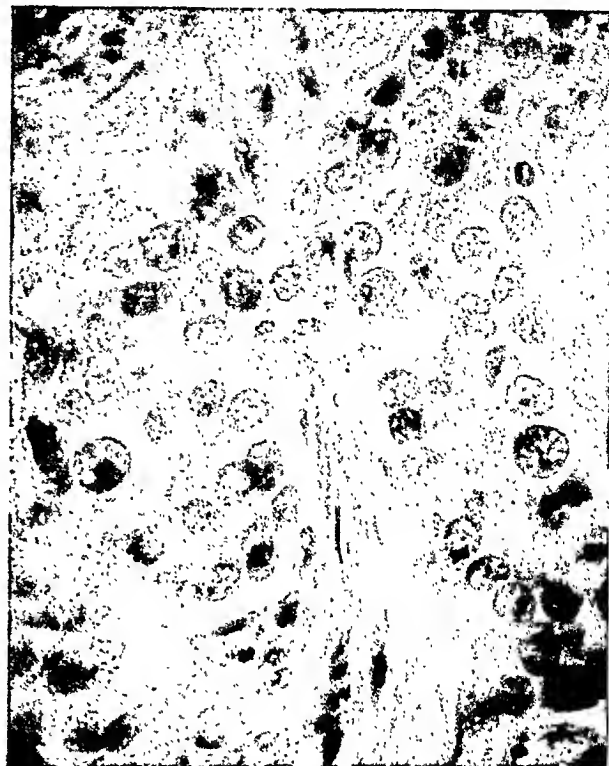
Fig. 2. A field from Fig. 1 (× 860).

The patient's weight, as a rule, had been 155–160 lb. The weight on examination was 131 lb. Blood pressure, systolic 116, diastolic 66.

Gradually he began to lose strength and had pain not only in the mass in the neck but also in the extremities, as well as through his chest. He was admitted to a neighboring hospital and the mass in the neck was explored January 12, 1929, (Oscar Fox). A vertical incision curved posteriorly at the upper end was made over the growth and the flaps dissected back. The growth was very extensive, attached to important structures such as the carotid sheath, the parotid gland, sternocleidomastoid muscle and also involved the spinal accessory nerve. Removal was impossible. A piece was removed, and after a histological study, a diagnosis of adenocarcinoma grade iv, (Broder's classification) was made (Figs. 1, 2). An x-ray of the chest at that time showed a definite shadow indicating a mass in the mediastinum extending to the right into the first interspace and under the first rib anteriorly. A second mass still more definite, rather spherical in outline, was seen in the center of the right lung at the level of the second and

third ribs and third interspace. The diagnosis suggested was, metastatic malignancy (Dietrich).
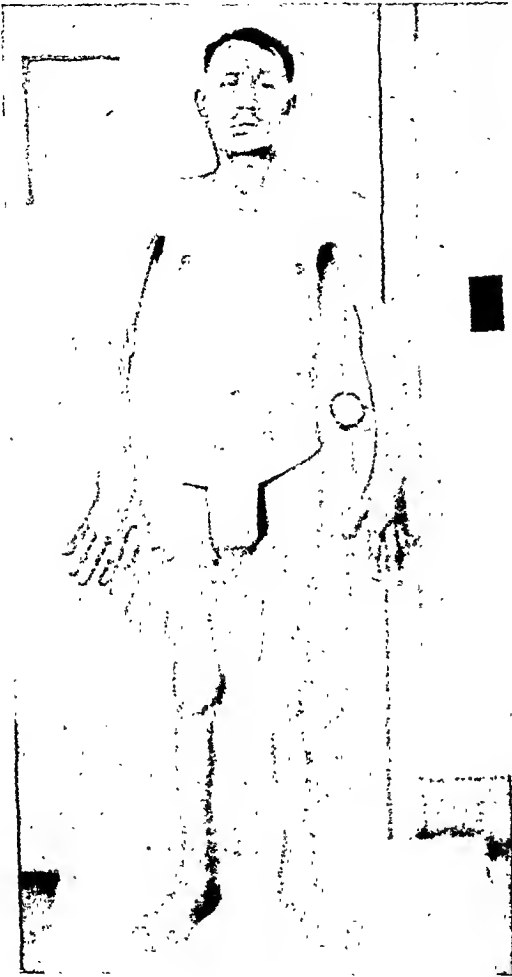
FIG. 3.

A dental x-ray showed numerous apical abscesses in the lower jaw. There was marked irritation of the soft tissues.

Family History: The patient was born in Poland and did not know whether his parents were still living. As far as he knew, they had always been well. There were two brothers living and well. The wife was generally well, as were also seven children. Three children had died in infancy.

EXAMINATION

On examination the patient (Fig. 3) appeared moderately emaciated, weak and apathetic. The skin had a sort of dark hue.

The head presented no gross abnormalities in size and shape. There was no ptosis of the

eyelids. The extraocular and intraocular eye movements were normal, as were also the eye grounds. The nose and ears were grossly

FIG. 4.

negative. The lips had good color. Eighteen teeth remained. They were in poor condition with marked caries and pyorrhea. The tongue

FIG. 5.

was diffusely coated and had a yellowish white color. The breath was slightly foul. The throat showed the tonsils removed. The left fossa

was apparently normal. On the right, along the anterior tonsillar pillar and part of the tonsil fossa, a firm mass was seen. There was

Fig. 6.

no free movement of either the anterior or posterior pillars on the right side. There was apparently no laryngeal involvement.

On the right side of the neck just above the angle of the jaw was a hard, irregular mass quite firmly fixed to the deep structures. The mass measured 8 × 6 cm. in diameter. It was slightly painful to touch and quite red as though inflamed. Over the mass there was a thin scar 3 cm. in length.

The thyroid gland was only palpable.

Chest expansion was only fair and slightly impaired on the right side. Slight palpation of the right chest in the region of the right scapula, chiefly on the inner border, was extremely tender. There were no palpable masses. Tactile fremitus was slightly increased in the region of the extreme tenderness. The breath sounds were vesicular, and there was resonance over both lung areas anteriorly and posteriorly. The apical impulse was not visible. The heart sounds were clear and regular.

The abdominal and rectal examinations were negative. The genitalia were also normal.

The extremities showed marked changes in the form of symmetrical enlargement. The

forearms appeared broadened and spade-like. In other words, the diameter of the forearms and wrists seemed almost uniform. By palpa-
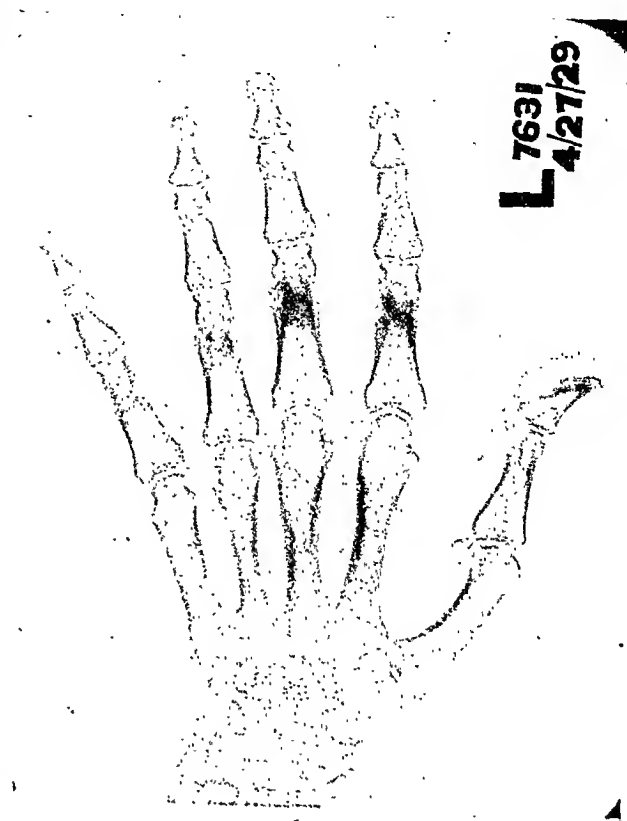
Fig. 7.

tion, the bones seemed near the skin. The joints all seemed heavier and broader and the knees, in particular, seemed to have fluid by palpation but there was no definite fluctuation. The movements of the upper extremities were clumsy. Walking was slow and cumbersome, not on account of any loss of control but the members seemed heavy and unwieldy. Muscular strength seemed diminished. There was a normal response to the patellar and Achilles reflexes.

The hands and feet (Figs. 4, 5) were generally enlarged. The ends of the digits were enormously rounded, the transverse and longitudinal diameters of the nails were practically equal presenting the general contour of small watch crystals. There was some dull pain in the extremities, but there was no increase in surface temperature or redness. The biceps and triceps reflexes responded normally.

The temperature was 100°F., pulse 100 and respiration 22. A complete blood count March 13, 1929, was as follows: hemoglobin 70 per cent, red blood cells 3,950,000, white blood cells 11,200. Differential blood count, poly-

morphonuclear 81 per cent, large mononuclear 2 per cent, small mononuclear 15 per cent, transitional 2 per cent. The red cells showed

FIG. 8.

FIG. 9.

slight pallor and slight variation in size. The blood Wassermann test, as well as the Kahn test were negative. The blood sugar was 118 mg., the blood urea 12 mg., the blood calcium 13 mg., and the blood chlorides 360 mg., all per 100 c.c. of blood. A spinal puncture revealed a pressure of 8 mm. of mercury. The fluid was clear and transparent. The tests for albumin, globulin and sugar were normal. The spinal Wassermann and Kahn tests were negative. Three urinalyses were grossly negative.
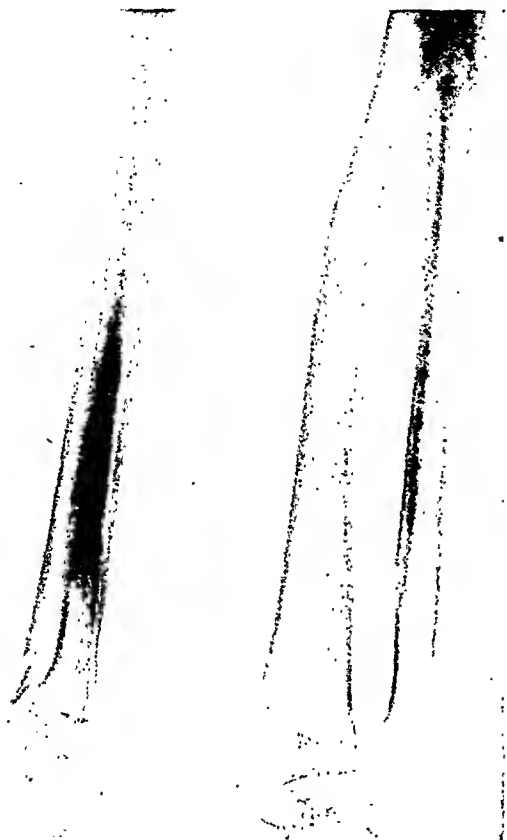
An electrocardiographic study showed only an occasional extrasystole.

A roentgenologic study was made of the entire skeleton. Stereoscopic lateral and anterioposterior studies of the skull, March 13, 1929, showed normal outer and inner tables without exaggeration of the vessel or suture markings. The sella showed no thinning of the floor or destruction of the anterior or posterior clinoid processes. There was no evidence of intracranial pathology.

Study of the chest (Fig. 6) shows an irregularly circular area of increased density, which nearly surrounded the hilum shadow of the right lung. The border of this density was not well defined and faded off into the lung tissue. It was about 2 × 2 in. in size and extended from the fifth to the seventh ribs posteriorly. The bronchiovesicular markings were not exaggerated on either side. The costophrenic angles were clear and both domes of the diaphragm appeared normal. The heart was of the vertical type and was not enlarged. The diagnosis suggested was metastatic malignancy.

Studies of the thoracic spine showed normal contour and alignment of the vertebral bodies without change in the intervertebral spaces. The posterior portion of the fifth rib on the right side showed partial bony destruction involving about three inches from the costovertebral articulation.

Roentgenologic study of the forearms and hands (Figs. 7, 8) in the anterioposterior and lateral views shows a periostitis of the radius, ulna proximal phalanges and the first metacarpals.

Studies of the legs (Fig. 9) shows a periostitis along the tibia and fibula. A periostitis is also seen along the proximal phalanges and the metatarsals.

CLINICAL COURSE

The patient was treated by deep x-ray therapy through the chest, as well as over the growth in the neck. Radium therapy to the growth in the neck was also given. The growth became smaller for a few months but later there was no apparent beneficial response.

The patient soon became progressively worse and was confined to his bed at home. His extremities became so weak that he could not be about. In May, 1929, he noticed that swallowing became more difficult to the extent that in July he could no longer swallow solid food, and by September he could take only liquids.

The cough became progressively severe, so that he coughed day and night. Coughing was associated with a slightly purulent expectoration.

October 9 he was readmitted to the hospital and was in a very emaciated and weak condition. There was a quite constant slight dusky cyanotic hue to the lips and to the finger and toe nails. This became definitely more apparent following one of his coughing spells. His right eye showed considerable bulging. The pupils were irregular, the right being markedly contracted and there was considerable edema of both eyelids of the right eye. The extraocular movements were not limited. The fundus was negative except for mild venous congestion. Saliva was profuse and some easily escaped at the angle of the mouth on the right. There was no drooping of the cheek.

The patient expired October 17, 1929. No post-mortem examination was made because the patient had expressed the desire that his body was not to be cut after death.

CRITICAL COMMENT

The patient was presented before the hospital staff. Because of the infrequency of this type of disease it was considered

worthy to report the case in the literature. The origin of the malignancy is not certain. It may have originated from the right tonsil or from a branchial arch, with multiple metastasis to the lungs and elsewhere, or it may have been primary in the lung with metastasis to the lymphatic glands of the neck.

The recognition of secondary pulmonary osteoarthropathy as a pathological entity, dependent upon disease elsewhere in the body is credited jointly to Bamberger 1889–1891 and Marie 1890. It is generally considered secondary to some obvious primary disease. In all, Locke collected only 5 cases in which the patients were otherwise well, and he concluded that these 5 cases lost much of their significance, because in none of the cases had a post-mortem examination been done.

In 1906 Alexander collected 77 instances of the disease from the literature.

In 1915 Locke made an exhaustive review of the literature and collected 144 cases. He proved quite conclusively that ordinary club-fingers and secondary pulmonary osteoarthropathy are stages of the same disorder.

In 1928 Brooks Palmer Stephens collected 156 cases, adding 5 from the records of the Mayo Clinic. He endeavored to show experimentally that the skeletal changes are not due to a toxin but rather to mechanical blood stasis.

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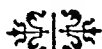
UNUSUAL STRANGULATED INDIRECT INGUINAL HERNIA*

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STRANGULATION of an indirect inguinal hernia with intestinal obstruction is a relatively common condition. The

from a sound sleep by severe abdominal cramps accompanied by nausea. An enema gave no relief and no flatus was expelled. During

FIG. 1. A. Constricting neck of peritoneal sac. B. Dilated obstructed ileum. C. Strangulated complete loop of ileum. D. Collapsed terminal ileum. E. Cecum. F. Parietal peritoneum. G. Indirect inguinal hernia sac in inguinal canal. H. Posterior wall of inguinal canal. I. Internal ring. J. Double layer of peritoneum making sac which held strangulated loop of intestine.

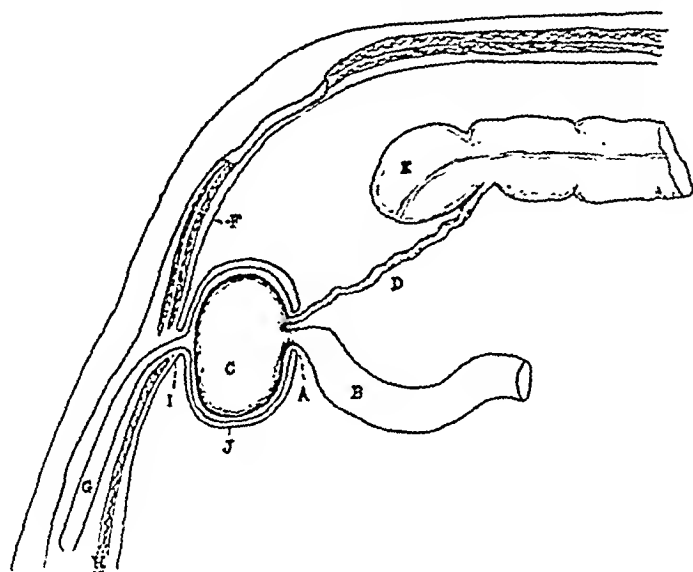loop of gut after entering the sac becomes constricted, edema develops, reduction becomes impossible, obstruction develops and gangrene of the involved intestinal loop follows. The site of constriction is more often found at the external inguinal ring than at the internal ring. In either case the strangulated loop occupies a portion of the sac in the inguinal canal or beyond the external ring. The case herewith reported presents unusual features which are worthy of note.

Mr. A. E. aged thirty-eight, a private chauffeur by occupation, had had a small reducible right inguinal hernia of several years' standing, for which he had worn a truss intermittently. On December 16, 1929 he changed four heavy automobile tires late in the evening. He had no symptoms of any kind until 4:30 A.M. the next morning when he was awakened

the day the pain became more severe, recurring every three to five minutes with intervening periods of comfort. Persistent vomiting developed.

When first seen at 8:30 P.M., sixteen hours after the onset of his illness, he appeared to be acutely ill and was vomiting thin watery fluid at frequent intervals. His temperature was 99° F. (mouth), respirations 22, and his pulse 90. Aside from a clean moist tongue the examination of his head, neck and thorax showed nothing noteworthy. His abdomen was slightly rounded and symmetrical with slight muscle spasm and poorly localized tenderness low in the right lower quadrant. There were no palpable masses in the abdomen, inguinal or femoral regions. A digital rectal examination showed no masses or tenderness. On auscultation of his abdomen tumultuous peristaltic sounds were heard coinciding with the attacks of pain and no sounds were heard during the intervals of comfort between the

pains. A leucocyte count showed 16,200 white cells with 84 per cent polynuclear cells.

Laparotomy for acute intestinal obstruction was performed through a lower right rectus muscle splitting incision. At the right internal ring was found a mass the size of a clenched adult fist extending into the peritoneal cavity. Entering this mass was a loop of moderately distended ileum and leaving it was a completely collapsed terminal segment of ileum (Fig. 1). On dividing the ring of peritoneum (A) an apparently gangrenous loop of intestine 2½ in. long was liberated. The application of hot saline pads to this segment of gut restored the circulation slowly. A purse-string suture of No. 1 chromic catgut was used to close the neck of the sac and no further treatment of the hernia was attempted. The laparotomy wound was closed in layers without drainage. His convalescence was uneventful; the wound healed by primary union and he was discharged from the hospital fifteen days after the operation. Two months later he resumed his usual occupation and repeated examinations have failed to reveal any evidence of a right inguinal hernia. Six months after operation his laparotomy scar was firm and there was no evidence of abnormality in the right inguinal region.

This case is reported to record an unusual type of strangulated indirect inguinal hernia and to again recall the importance of early symptoms, recurring wave-like abdominal cramps, nausea and vomiting, non-passage of feces and flatus, in making a diagnosis of acute intestinal obstruction.
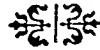
ISOLATED DIVERTICULUM OF THE JEJUNUM*

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DANVILLE, ILL.

DIVERTICULA may occur in any hollow organ, e.g., bladder, tube or any part of the gastrointestinal tract. They are especially prone to occur in the alimentary canal beginning at the esophagus and in every other section throughout its course, even the appendix.

Previous to the use and interpretation of the opaque medium in roentgen diagnosis, they were discovered only at post mortem or perhaps as a cause of intestinal obstruction. About two-thirds of the reported cases were discovered post mortem. Thanks to the roentgenologist we are now able to recognize them and may plan for their surgical removal, if they cause symptoms.

The literature on this subject is comparatively brief, the greatest number of case reports covering the past five years, although the first was found by Cooper at autopsy in 1844. An outstanding fact of the literature shows the presence of multiple sacculi and they occur late in life. This would support the hypothesis of an acquired lesion.

From a search of available material it seems that the preoperative diagnosis and successful removal of the lesion is not over half a dozen, the first by Case.[1] In all but two in a summary of 33 cases[2] the position was on the mesenteric side of the bowel. In the author's case, in which there was a single diverticulum, the opening was directly opposite the mesenteric attachment. A solitary diverticulum is quite the exception: in nearly every report we have described multiple openings in which the tumor may vary from the size of a pea to that of a walnut. The interest in this subject by x-ray workers has shown the comparative high frequency of duodenal diverticula, occupying any place along its course. Diverticula, then, may occur in any portion of the small bowel from the stomach to the colon, the least frequent site being the jejunum. Even when present, multiple tumors (diverticulosis) are the rule.

There can be no proof established as to the cause of this lesion. Those advanced suggest congenital defects: intra-intestinal pressure, traction, atrophy of the muscular coat due to age. These are of academic interest only and of little practical value to the surgeon. The position of the diverticulum on the circumference of the gut may add definite operative problems, e.g., nearly all are on the mesenteric side, that is on the concave side. Any removal, therefore, contemplates the vascular integrity of the bowel. This becomes even more serious when we have inflammation present with edema. In this instance a complete resection of the bowel might offer more promise of recovery than an attempt to remove the tumors individually.

All must feel a sense of obligation and appreciation for the cooperation of the roentgenologists in the matter of diagnosis. In fact a diagnosis would not be possible with any degree of certainty, if based on clinical and other laboratory data. The internist as well as the surgeon must, therefore, look to the x-ray department for substantial help in recognizing this rare anomaly. It seems likely that some cases diagnosed as perforating ulcers of the duodenum, not checked by an exploratory examination, may be diverticula.

From the reported cases, confirmed by operation, no fact seems to stand out more clearly than that this lesion does not have a definite symptom complex. In a few cases in which intestinal obstruction was diagnosed the cause was never named previous to operation. This, however, is true: the complaints are of pain in the upper abdominal region, and of long standing.

We wish to report a case of isolated diverticulum, diagnosed as such, operated with relief of symptoms.

CASE I. Mrs. M. C. (Lake View Hospital No. 34903, Danville, Ill.) aged forty-two, entered the hospital Jan. 31, 1928, giving a vague history of stomach trouble for the past three years. Chief symptoms of which she complained were distention and cramps in the upper abdomen especially when solid food was taken. There were frequent eructations of gas and often vomiting. This vomitus was never described as acid. If the stomach was not emptied the discomfort often lasted during the night. There was marked constipation.

Family History: The only thing of importance was the death of her father at forty-six of some stomach lesion.

Personal History: Usual disorders of childhood. Married at seventeen. Never pregnant. Her best weight 130 lb.; present weight, 108 lb. Urine negative. White count 5750.

For about six months before her admission she had been treated for appendicitis, but we could elicit no history of a definite attack. Believing she had this disease she consulted Dr. A. C. Holley of Attica, Ind. and requested an x-ray examination.

This was done Jan. 23, with the following findings: Stomach low in abdomen. Found to be one-fourth filled at end of six hours. An opaque shadow, rounded in shape, in the right middle abdomen on level of third lumbar, freely movable and apparently without pain when manipulated. This opaque shadow was present at the end of thirty-six hours after ingestion. A diagnosis of jejunal diverticulum was made.

Operation: On Feb. 2 an operation was done: Gall bladder, stomach and pelvic organs apparently normal. The appendix was removed and reported "chronic productive appendicitis." Fifteen inches below the duodenojejunal angle a pouch (single) was found on the convex side of the jejunum, corresponding in size and shape with the film. An opening 1 cm. in diameter communicated with the bowel. The diverticulum was removed.

Dr. E. A. Kraft, pathologist, reported as follows:

Macroscopic: The specimen consists of a rather thin, spherical sac with a wide opening at one pole. It measures 1½ in. in diameter and shows intestinal mucosa inside. The latter is somewhat hyperemic and covered with mucus.

Microscopic: The sections of the intestinal sac show the usual structures of the jejunum without any special evidence of pathology, except for a moderate circumscribed round cell infiltration within the muscle layers.
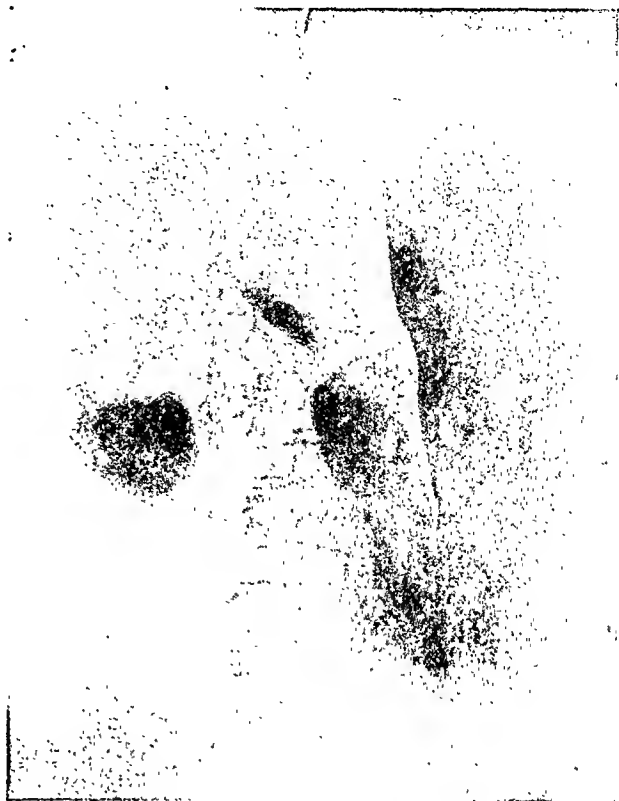
FIG. 1. Isolated diverticulum of jejunum.

The surgical recovery was without incident. The patient left the hospital at the end of seventeen days in good condition.

Two months after the operation, Dr. Holley reported that the stomach plane is much higher than in the first picture and is free from barium in six hours. The patient is gaining in strength and weight and is free of symptoms.

OUTSTANDING FACTS IN THIS CASE

1. Single pouch, removed without intestinal resection.
2. On the free edge of intestine.
3. Thirteen inches below duodeno-jejunal junction.
4. Recognized as a diverticulum before operation.
5. Removed without intestinal resection.
6. Absence of any other pathology in abdomen.
7. Relief of symptoms, gain in weight.

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PAIN IN THE TESTICLES

A SYMPTOM OF RETROPERITONEAL TRAUMATIC RUPTURE OF THE DUODENUM*

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THIS case report is of interest not only on account of the location of the lesion but because of the characteristic diagnostic symptoms, which are not mentioned in the literature.

The patient, a twenty-four-year old male, was struck in the upper abdomen by the steering wheel of his automobile when it collided with a telephone pole. He was apparently uninjured, though intoxicated, and walked home from the accident. During the night he was awakened by gripping pains in the upper abdomen and terrific acute pain in both testicles.

Nine hours after the accident he entered the San Francisco Hospital and on examination, there was found extreme rigidity and tenderness of the entire abdomen with the area of greatest tenderness in the epigastrium. Rectal palpation revealed emphysema of the tissues of the pelvis, the crackles being easily elicited. The pulse was of good quality; blood pressure was 90/65; red blood count 4,400,000; hemoglobin 85 per cent; white blood count 4300; with 46 per cent polymorphonuclears, 32 per cent small lymphocytes, and 22 per cent large lymphocytes. A diagnosis was made of traumatic rupture of the bowel, and the patient was taken to the operating room.

A right paramedian incision was made and a considerable quantity of gas or air was found between the transversalis fascia and the peritoneum. Within the peritoneal cavity there was a large quantity of bile-tinged, hemorrhagic exudate, the colon and small bowel were cyanotic, congested and slightly distended. No perforation was found.

The incision was then extended superiorly and the stomach and pancreas found to be uninjured. A discoloration and edema of the peritoneum in the region of the descending and transverse duodenum attracted attention to this structure. When the peritoneum to the right of the descending duodenum was opened, a rent in the posterior wall of the third portion of the duodenum was found. The retroperitoneal tissues were deeply bile-stained, and fat necrosis was present. The wound in the duodenum was repaired and two cigarette drains left in the retroperitoneal region. An enterostomy was then done high in the jejunum. The abdomen was filled with warm saline solution and closed. The patient died the following day.

CONCLUSIONS

1. The presence of gas or air in the pelvic tissues that can be palpated by rectum is indicative of a retroperitoneal tear in an air or gas containing viscus.

2. When, upon making an abdominal incision, gas or air is found between the peritoneum and transversalis fascia in a patient suffering from an injury a retroperitoneal rupture of a hollow viscus should be suspected.

3. Early excruciating pain in the testicles following a severe trauma to the upper abdomen indicates a retroperitoneal rupture of the duodenum with a spreading out of bile beneath the peritoneum so as to irritate the testicular nerves, the sympathetic chain accompanying the spermatic artery.

OPERATION FOR THE RELIEF OF RECURRENT DISLOCATION OF THE SHOULDER

WITH PRESENTATION OF PATIENTS*

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SINCE the operation for the relief of recurrent dislocation of the shoulder was first described in the *Journal of Bone and Joint Surgery*, January, 1929, over 20 cases have been operated upon by various surgeons with uniformly good results.

Most of the cases of recurrent dislocation of the shoulder which we see follow trauma. When the arm is raised from the body beyond a right angle, the greater tuberosity strikes the acromion process. If the hyperabduction is continued, the acromion process acts as fulcrum and the head of the humerus is lifted from its socket, tearing away the capsule of the joint in front and below the glenoid cavity. After once leaving the socket, subsequent movements determine the various positions around the glenoid. Thus we have anterior, posterior, or upward dislocations. The latter is rare and usually associated with fracture of the acromion.

The *pathology* of the recurrent dislocation of the shoulder resolves itself around the various structures which make up the joint, namely, bones, capsule and muscles.

In the bony group, we have many defects in the head of the humerus either acquired after the first dislocation, or due to atropy of the head, infantile paralysis or congenital defects.

In the capsular group, we may have detachment of the capsule from the anterior or the inferior margins of the glenoid. Enlargement of the joint from relaxation following repeated tears.

In the muscular group, we have weakness of the supraspinatus and infraspinatus muscles with contraction of the pectoralis major, teres minor and latissimus dorsi.

From the pathological consideration, we see that in most cases there is usually a combination of two or three of these factors present and to repair only one leaves a loophole for recurrences.

The operation which will now be described is practically the same as the original except for a few additional points.

The incision begins just to the outer side of the coracoid process and passes down along the anterior border of the deltoid for about 4 in. The pectoralis major and the cephalic vein are retracted inward, and the deltoid muscle outward. The tendon of the long head of the biceps is exposed up to its origin. To do this it is necessary to divide the transverse humeral ligament which holds the tendon in the bicipital groove and to split open the capsule in the line of the fibers continuous with the transverse humeral ligament. The tendon of the long head of the biceps is divided 1 in. below the cut margin of the transverse humeral ligament, after placing stay sutures of black silk in the proximal and distal parts, so that the ends may be under control. The elbow is flexed at about 45° during this step of the operation.

A hole is then drilled through the head of the humerus beginning just below the transverse humeral ligament, using a quarter-inch drill. This should be so directed that it comes out at about the center of the articular surface of the head.

A flexible probe is passed through the hole and the arm is rotated out so that it is easier to thread the probe. Next the tendon is pulled through and united with its distal part, using black silk.

The transverse humeral ligament and the capsule are sewed with a continuous No. 1 plain catgut; the skin is also sewed with No. 1 plain catgut.

The shoulder is put up in a simple Velpeau bandage, reinforced with adhesive plaster, with arm close to the chest and the elbow flexed at 45° and kept up for two weeks.

CASE REPORTS

CASE I. Patient S. C. aged twenty, occupation boxer, gave history of "throwing a punch" while boxing three years ago. This was followed by extreme pain and loss of function of the right shoulder. After some manipulation, he felt something snap back into place in the shoulder. Since then he has felt the shoulder slip in and out of place on the average of five times a week. When first seen he was able to voluntarily dislocate the shoulder and replace it himself.

Patient was admitted to the Hospital for Ruptured and Crippled on March 29, 1928 and operated upon March 20. He had the usual postoperative reactions and was discharged April 6, 1928, six days after operation.

The shoulder was immobilized for two weeks, followed by heat and massage for one week, then manipulation was added. Five weeks after operation the patient had complete function. This patient has been followed up for two years and has had no recurrences.

CASE II. Patient E. H. aged twenty-seven, occupation none, due to numerous epileptic fits. The shoulder dislocated on the average of twice weekly during his fits. This has been going on for the last four years and during the last two months it has been getting difficult to reduce the dislocation. The mother brought the patient to the hospital with the hope of reducing the number of epileptic fits as she felt the constant worry of her son about the shoulder dislocations was making his attacks more frequent.

Patient was admitted to the Mountainside Hospital September 8, 1928 and operated on the following day. Discharged from the hospital in ten days. Function was complete in seven weeks. He was free from dislocation until his death in a motor accident January 17, 1930. His mother states that since operation he had had only two fits.

CASE III. Patient E. P., aged twenty, occupation student at college. One year ago she fell, fracturing elbow and dislocating the right shoulder. The shoulder dislocation was not discovered until one week after the injury but was easily reduced. When she returned to college after three months she dislocated the shoulder while in the gymnasium. Capsulorrhaphy was performed at a hospital in Philadelphia, June, 1928. This held the head in position for fourteen weeks. The parents took the patient to Berlin where the mother states an extensive muscle operation was performed November 4, 1928. She remained in the hospital for three weeks. Shoulder dislocated two weeks after discharge from the hospital. On May 14, 1929 this operation was performed at the Mountainside Hospital and to date there have been no recurrences. Patient sailed for Europe in February, 1930.

CASE IV. Patient G. R., aged twenty-five, occupation salesman. During a friendly exchange of blows, patient threw right shoulder out of joint. For the last two years he has had the shoulder dislocated by simply putting the hand behind the back. When first seen at the clinic the patient had a dislocation of the right shoulder which he could not put back in place. This operation was performed November 5, 1929. Discharged in ten days. Complete function in five weeks.

SUMMARY

1. The operation is simple to perform.
2. It can be used in all cases, no matter whether the cause be bony, capsular or muscular.
3. There is practically no restriction of motion at the shoulder after the operation.
4. Period of convalescence is short.

DISCUSSION

DR. LEO MAYER: I do not think enough can be said in praise of this brilliant and simple operation. We are all delighted with its effectiveness and its simplicity. I want at this time to make a confession. I thought that I had devised an operation superior to Dr. Nicola's. I, too, had had the idea that the biceps tendon could be utilized as a stay ligament. Instead of making a new tunnel for it through the center of the head, I roughened the bicipital groove, replaced the tendon within it and ran a portion of it through a short transverse tunnel. In addition the biceps was reinforced with a strip of fascia lata which ran through the acromian process and a

transverse tunnel through the greater tuberosity. My operation was more complicated and certainly less effective for of the 3 patients in whom I did it, 2 of them had recurrences of the dislocation. I reoperated and did Bankart's operation. This is a difficult procedure necessitating a wide exposure of the joint. Certainly Nicola's operation is far simpler, and in the future it will be my choice in the treatment of recurrent dislocation of the shoulder.

DR. R. H. PATTERSON: On two occasions I have used Dr. Nicola's operation and it has been very successful in both instances. One of the cases was a young man of twenty-one, an epileptic, who had dislocated his shoulder twelve times in the year preceding the operation. I operated on August 2, 1929, and it healed very promptly. He has been seen since, and has a normal range of motion. The other case was that of a man thirty-five years of age, a pole climber in the employ of the telephone company. He had had his shoulder dislocated thirteen times in the year previous to the operation; he could dislocate it at will. He, also, was operated on in 1929, and now has a normal range of motion, but he has a limitation of 25 degrees of abduction. The other motions are normal and he is completely satisfied.

The operation is justified on comparative anatomical grounds. Dr. Stockard called my attention to the fact that in the dog the head of the biceps runs through the head of the humerus and he was surprised that the clinicians had not discovered this long before. Dr.

Nicola's operation has proved of great use in the hands of my friends in fracture dislocations of the shoulder. The dislocation of the head of the humerus is practically beyond control except by open operation; and if at the time of operation the fracture ends are approximated and reduced, and the long head of the biceps pulled through the humerus, as in Dr. Nicola's operation, you have your fragments in proper position, etc.

DR. MATHER CLEVELAND: Three or four years ago Dr. Percy Roberts came to the Anatomical Department of Columbia University and I showed him two or three shoulders. He was interested in the subject of habitual dislocation of the shoulder joint. He made a statement at that time that he did not believe one could dislocate the head of the humerus if the transverse humeral ligament was intact and the long head of the biceps was functioning properly. I would like to ask Dr. Nicola and the other surgeons if they have found this transverse humeral ligament had been torn or injured in any way. I can not believe an intact transverse humeral ligament would necessarily prevent a dislocation.

DR. NICOLA (*closing*): Dr. Patterson stated that in 1 of his cases there was some restriction of abduction. This can be obviated by completely abducting arm before sewing up the wound.

As for answering Dr. Cleveland's question, I have not seen any injury to the transverse humeral ligament.

UNUSUAL TUMOR OF THE NIPPLE*

ELLIS FISCHEL, M.D., AND LOUIS H. JORSTAD, M.D.

ST. LOUIS, MO.

PAGET'S disease of the nipple and its relation to dyskeratosis in general has recently been discussed by J. Frank Fraser.[1] The pathogenesis of Paget's disease is still a disputed question; however, the work of Fraser and others tends to support the view that the lesion is not a primary one from the skin of the breast, but is a metastasis from duct carcinoma.

In the literature and in standard textbooks on pathology, one finds little reference to tumors of the nipple or even more strictly speaking, changes in the skin of the nipple. Paget's disease is referred to as a specific, chronic, progressive disease, originating in the milk ducts below the nipple, or in the squamous epithelium of the nipple. The typical picture in Paget's disease is that both the epidermis and the milk ducts are affected and one can always

[1] FRASER, J. F. *Arch. Dermat. & Syph.*, 18: 809–25, 1928.

* Submitted for publication May 9, 1930.

find typical swollen, rounded, clear-staining hydropic cells in the epidermis. These are known as Paget's cells.

FIG. 1. Low-power photomicrograph of upper portion of nipple from case reported. Cf. Fig. 3.

A case coming to our observation some time ago was that of a married woman twenty-five years of age, who presented the following history:

Seven years ago a verrucous growth appeared on the nipple. This had increased somewhat in size, and it became alternately crusted up to three years ago, at which time the growth was destroyed by desiccation. The resultant wound had never healed. Quite recently she had x-ray treatment to the area, without any improvement in the healing. Six months ago, following a normal pregnancy, she nursed her child for a period of two months; then the nipple became so tender that further nursing was unbearable. Upon physical examination at the first visit to our office a few weeks ago, the nipple showed a fissure and in the outer hemisphere there was a definite irritated-appearing reddish growth, measuring 3 × 2 mm. in diameter. The nipple itself was indurated, and there was considerable moisture about the growth. Both the mammary glands were somewhat lumpy, yet there were no definite tumors in either. The one with the affected nipple presented no difference to palpation from that of the other. Thus, the anatomical picture was more that of a crusting of the nipple with an inflammation

underlying it. The skin of the breast surrounding the area was not thickened, but appeared normal in character and consistency. The

FIG. 2. Same as Fig. 1, except taken from lower portion of nipple. Cf. Fig. 4.

nipple and the normal areolar tissue around it were excised. The microscopical findings reveal a lesion which is inflammatory, hyperplastic and keratotic in character. The epithelium is thickened; the keratosis is superficial; there is no edema in the epithelium, neither are there any abnormalities in the cell outline. In that the whole nipple was removed, the ducts can be followed throughout their extent and the epithelium of the ducts, a short distance below the surface, appears normal. Occasionally there is a small amount of inflammation, evidenced by round cell infiltration surrounding the ducts and a desquamation inside of the duct. However, the main lesion is in the epidermis, corium and upper portions of the ducts; the round cell infiltration is most marked in the corium. There is a slight amount of papillation of the epithelium, but there is no definite verrucous formation (Fig. 1).

The interest in this case is whether we are dealing with an early Paget's disease, one earlier than those which have been previously described in the literature, or whether the lesion is that of a keratosis of the skin such as we see in other parts of the body, or whether most of the changes seen at this time are secondary to the previous

treatment for the removal of a verrucous growth.

Histologically, the picture does not fit

FIG. 3. Low-power photomicrograph of upper portion of nipple which appeared grossly normal (described in text). Cf. Fig. 1.

into the early case of Paget's disease, which has been described in the literature; but we do not have available the breast tissue and thus it will be of interest to follow this case very closely. If a carcinoma of the breast itself occurs within a reasonable period of time, it will be interesting to note the type of this carcinoma, and whether or not it fits into a true Paget's disease of the breast.

On account of the lack of definite histological study of the nipple of the female breast, we made paraffin sections of a number of nipples which appeared normal grossly. We obtained these from breasts in which the lesion was in the peripheral portion of the glandular tissue so as not to be connected directly with the nipple. We were fortunate in obtaining a nipple from a woman of the same age, whose breast had lactated once, the breast being removed on account of a precancerous cystic mastitis in that portion of the breast tissue which extends toward the axilla. The

patient with the nipple in question had nursed one child also. As shown in Figures 3 and 4, the epithelium of this nipple is

FIG. 4. Same as Fig. 3, except taken from lower portion of nipple. Cf. Fig. 2.

devoid of hair follicles or sebaceous glands; there is no crusting or keratosis; the corium and subcutaneous tissue are normal; the lactiferous ducts are lined with well demarcated epithelium (best seen in lower edge of Fig. 4), with a small amount of round cell infiltration surrounding them. The relationship of elastic tissue to connective tissue is demonstrated throughout both figures, and the absence of elastic tissue in the major portion of the pathological area in Figures 1 and 2, as compared to this nipple, is definite. The supporting tissue in the abnormal nipple stains more deeply with eosin. The greater amount of glandular tissue, the round cell infiltration, and areas of definite hyperplasia of the lactiferous tubules are the chief differences histologically that the diseased nipple shows from the normal selected.

Sections from nipples removed from breasts of older individuals varying in age from forty to sixty years differ histologically from the normal nipple shown in

Figures 3 and 4 in one particular, only in that the corium and upper stratum of connective tissue contain numerous sebaceous glands. From our study, these are greater in number at the fifty-year than at the forty-year period. The elastic tissue is less and there is more marked round cell infiltration about the lactiferous ducts than in the younger individual. However, the structure of the glandular portion is very similar in all of the grossly normal nipples studied.

CONCLUSIONS

Photomicrographs of an unusual tumor of the nipple are shown to demonstrate a possible relationship between epithelial changes of a keratosic nature and carcinoma of the glandular epithelium of the nipple.

EXOPHTHALMIC GOITER IN A CHILD AGED FIVE YEARS*

SAMUEL S. SHOUSE, M.D.

BROOKLYN, N. Y.

ALTHOUGH exophthalmic goiter is seen rather frequently in adults, most authors agree that its appearance before puberty is comparatively rare. Thus in a survey of the literature of the twenty years prior to 1922, Buford[1] found only 18 cases of exophthalmic goiter in children under twelve years of age, and of these 8 were in children under five years. In 1901 Barret[2] collected 39 cases in the literature. Three of these patients were under five years of age, 11 were between five and ten years, and 25 were between ten and fifteen years of age. He estimated that the ratio of children to adults was 1 to 50. Helmholz[3] in 1926 reported 30 cases in children under fourteen years in a series of 3432 patients with exophthalmic goiter at the Mayo Clinic. The youngest in this group was a child three years old, whose symptoms were said to have commenced at eleven months. Lahey's[4] youngest case was also a child of three years. Hertzler[5] operated for exophthalmic goiter in a child three and one half years old.

The impression that unmistakable exophthalmic goiter seldom occurs before puberty is further borne out by the fact that in approximately 1000 cases of this disease submitted to operation at the Long Island College Hospital, the onset was definitely before puberty in only 4 instances, namely, 1 case in which the disease began before five, 1 in which symptoms began at seven, and 2 cases in which symptoms appeared at eleven years. Through the courtesy of Dr. Arthur Goetsch, I am permitted to report the youngest of these cases.

REPORT OF CASE

D. R., an Italian girl of barely five years, was brought to us first on April 24, 1929. The complaint, obtained from her mother, was nervousness, hyperirritability, fatigue, enlargement of the neck, and protrusion of the eyes.

Family History: Her father had died eight months previously of pulmonary tuberculosis. Two maternal aunts were said to have nontoxic goiters, and a cousin died five months after an operation for goiter. Examination of her mother disclosed mild hyperplasia of the thyroid gland.

Past History: The child was born three weeks prematurely and at birth weighed $4\frac{1}{2}$ lb. She had severe tonsillitis at the age of two years, which led to the removal of the tonsils and adenoids soon afterward. She also had varicella when two years old and pertussis at the age of three years. Otherwise her health had been good and she had not seemed nervous. Her best weight had been 53 lb. shortly before the onset of the present complaint.

Present Illness: Five months previous to

April 24, 1929, at the age of four years and nine months, she was frightened very severely. Soon after that she became very irritable and

brown iodine solution on alternate days, stopping one week before the first visit.

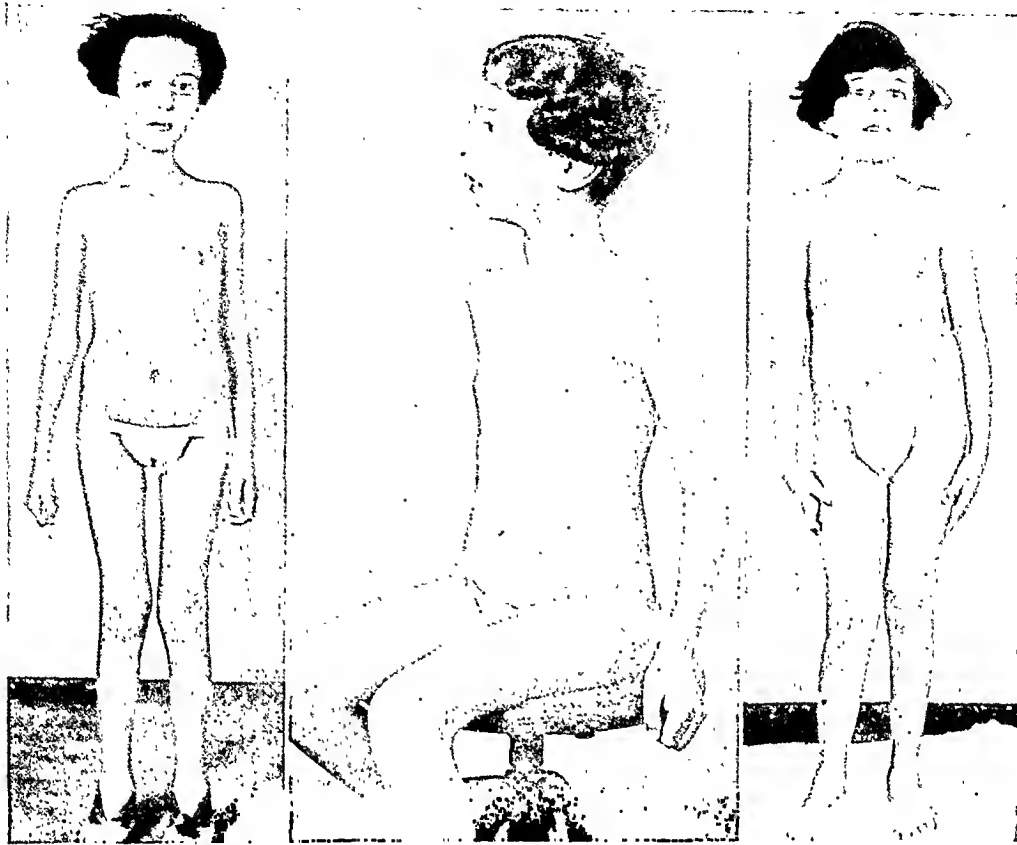*Physical Examination:* The patient seemed

FIG. 1.   FIG. 2.   FIG. 3.

FIG. 1. Preoperative photograph of the child, five years old, showing marked emaciation and exophthalmos. Blurring is result of her restlessness and inattention. Numerous exposures were necessary to obtain a picture at all satisfactory.

FIG. 2. Lateral view showing thyroid enlargement.

FIG. 3. Six weeks following operation. Note general improvement in nutrition and bearing and decrease in exophthalmos.

developed prominence of the eyes. At that time a physician observed fulness of the neck. She soon became extremely nervous and had a change in disposition, becoming peevish, irritable, and very difficult to manage. She was very restless and seemed unable to concentrate on anything. Her sleep was poor, and interrupted by much tossing about. The exophthalmos and the goiter continued to become more prominent and a marked tremor developed. Her breathing was very rapid and she had mild dyspnea on exertion. The pulse rate was said to have been 165. She had palpitation and some throbbing in the head. Fatigue, flushing and sweating were prominent, and there was desquamation of the skin of the palms at the onset. She had lost 6 lb. in spite of an excessive appetite. During the previous four months she had taken two drops of a

extremely apprehensive, with an expression of anxiety and great excitement. She was very restless and fidgety and was continually moving about in an uneasy manner. The *eyes* showed marked exophthalmos, a staring appearance, brightness of the corneae, extreme widening of the palpebral fissures, lid-lag, weakness on convergence, and dilatation of the pupils. The *mouth* was held open. The facies was distinctly of the adenoid type. The lips were dry and parched. The tongue was red and had prominent papillae. There were remnants of lymphoid tissue in each tonsillar fossa. The *neck* presented a definite uniform enlargement, measuring 27.25 cm. in circumference. Both lobes and isthmus of the thyroid were easily felt, being smooth and firm. There were definite thrills and bruits over both superior poles and over the gland itself. The

heart presented heaving pulsations over the precordium. The sounds were forceful and there was a short systolic murmur over the

tives, such as amytal and quinine hydrobromide. During the next three months there was a gradual improvement in the nervousness
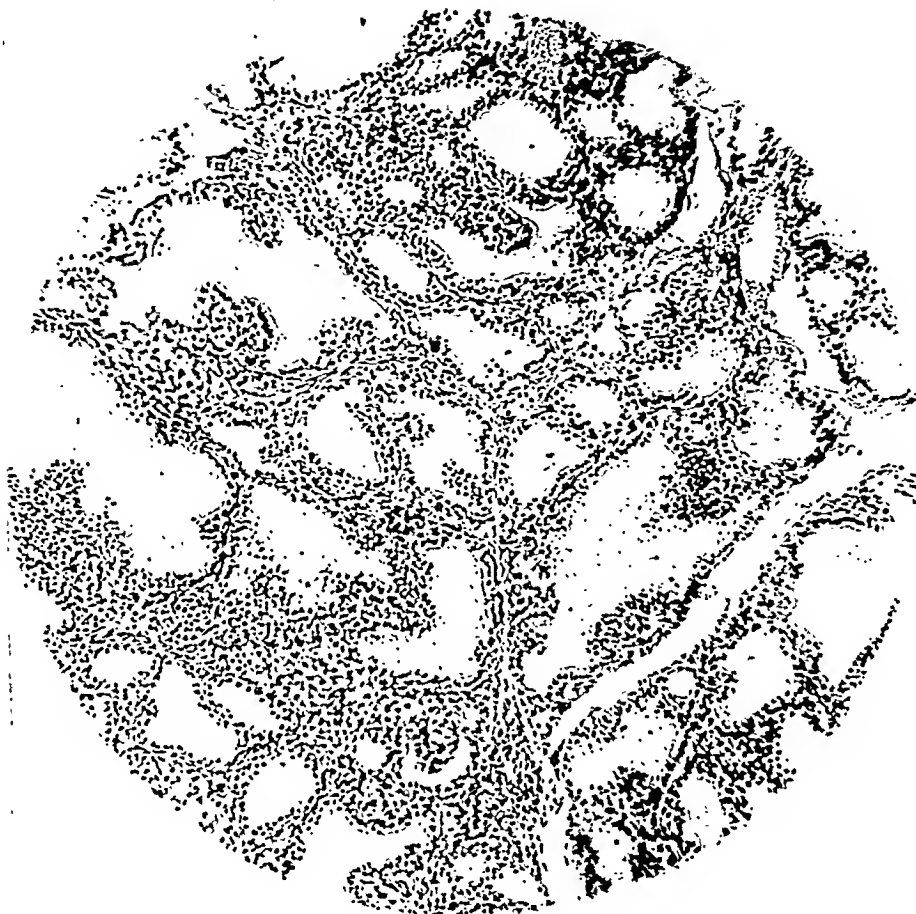
FIG. 4. Photomicrograph of excised tissue. Note failure of involution and rather marked hyperplasia which persisted in spite of intensive iodine treatment. A single adequate course of iodine would have been more effective and have caused this condition to revert to the colloid, or "resting" stage.

apex. The rate was 140–150, and the rhythm was regular. The blood pressure was 120/40. The nail beds were pink and showed indefinite capillary pulsations. The *skin* was flushed, warm, and showed pronounced dermographism. There were beads of perspiration on the neck, and the palms were wet. The extended fingers presented a marked fine tremor, and the knee jerks were hyperactive.

Laboratory Findings: Red blood corpuscles, normal; W. B. C., 12,000; polymorphonuclears 65 per cent; lymphocytes 35 per cent. Urine normal.

Diagnosis: Exophthalmic goiter with marked hyperthyroidism. Iodine exacerbation.

Treatment: She was urged to rest, although not confined to bed, and was given mild seda-

and fatigue and, to a slight degree, in the tachycardia. She was then given Lugol's solution, 5 drops three times a day for ten days. This caused a great improvement in all of the symptoms and a decrease of the heart rate to 100. The thyroid gland showed the usual prominence and firmness that follows administration of iodine but not in so striking a manner as that following an initial intensive course of this drug. On August 5, 1929, a double resection was performed by Dr. Arthur Goetsch, a total of 13 gm. of tissue being removed. This was accomplished without difficulty and, excepting for a brisk reaction on the following day, the postoperative course was uneventful. At operation the gland seemed to be about 50 per cent larger than normal.

In spite of the iodine it showed great activity, as evidenced by its "beefy" appearance and the vascularity. The left lobe contained more colloid and was less vascular than the right.

Pathological Examination: Microscopic study showed the characteristic hyperplasia of exophthalmic goiter although there was a moderate increase in the colloid which stained pale pink. The acini were large and irregular in outline because of the polypoid infoldings. The lining cells were tall, columnar, and had deep staining nuclei. There was a moderate increase in the stroma, but very little lymphoid tissue was present.

Subsequent Course: Before she left the hospital the nervousness, emotionalism and irritability had diminished to such an extent that she was not unlike other children in her behavior. The pulse stabilized itself at 90–100. Ten months after the operation, she shows great general improvement. There is no tremor and practically no nervousness, but a moderate exophthalmos persists. She weighs 61 lb., which represents a gain of 14 lb. since the operation. Her pulse rate is 90. The neck is normal in size and appearance and there are no thrills or bruits.

COMMENT

Apparently the severe fright which this child experienced was sufficient psychic trauma to precipitate the disease. On the other hand, the death of her father is said to have caused no emotional effect. The presence of goiter in several members of her mother's family is significant. Others have emphasized hereditary tendencies in similar cases. The history of previous tonsillitis is interesting in view of the well recognized lymphoid hyperplasia that occurs in exophthalmic goiter.

This case illustrates the very bad effects of long-continued administration of iodine in hyperthyroidism. It should be appreciated that iodine is very valuable in the preoperative preparation of the patient with exophthalmic goiter, and when so used it should be given intensively, and should not be continued longer than two to three weeks. When given intermittently, or continuously for several weeks or longer, the symptoms become markedly aggravated and the patient who might ordinarily stand a major procedure without great danger is converted into a serious operative risk. In fact, operation must frequently be deferred until the system has had time to eliminate the iodine. Thus in the foregoing case the child when first seen by us was in a state of marked iodine exacerbation. It was necessary to wait approximately four months to permit the elimination of the iodine from the thyroid and thus render the gland once more capable of responding favorably to a brief period of intensive iodine administration. Unfortunately, subsequent courses of iodine are not as effective as the primary one. Our case confirms this fact very strikingly both clinically and pathologically. The gland showed only a moderate increase in colloid and, notwithstanding the intensive iodine treatment, it still presented considerable hyperplasia. It is deplorable that so many physicians persist in treating all types of goiter with iodine.

Although only moderate benefits were derived from general medical and sedative treatment, a rather striking improvement has followed bilateral resection. We realize that this patient cannot as yet be discharged as permanently cured, hence we plan to observe her at regular intervals until after puberty to note any signs of recurring hyperthyroidism. It is well known that even in adults, remnants from subtotal resection in Graves' disease occasionally hyperplase and cause recurrence of symptoms. It would seem that the tendency to hyperplasia might be still greater in the growing child.

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5. HERTZLER, A. E. Diseases of the Thyroid Gland. Ed. 2, St. Louis, Mosby, 1929, p. 17.

The American Journal of Surgery is truly independent and enters into no "entangling alliances." It publishes many papers read before the leading surgical societies of the Country, but it is *not* "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published merely because "it was read at the meeting."

EDITORIALS

NOTES AND COMMENT

WE look toward the future with optimism, curiosity and hope. These are but human traits. In going through lay magazines we are struck with the editorial announcements that next month there will be offered the greatest feature article, the most perfect story, the biggest, greatest, etc., number ever offered. The future always has the best in store. Superlatives deal with tomorrow.

And so, should we be satisfied to hit the conventional note we would ignore what has passed and turn to the months ahead. Before we finish we will deal with 1931. However, we pause and dwell with 1930, just gone into history.

It was twelve months ago that publisher and editor decided to double the size of THE AMERICAN JOURNAL OF SURGERY. We were forced to make this move. Three years ago when we became editor

we lost sleep wondering how we would fill one hundred pages of reading matter each month. We implored our friends to get busy and produce articles; we wrote begging letters by the score. Often we were discouraged. Things just did not seem to click. Then, imperceptibly at first, material began to arrive daily. We soon realized we had accepted more than we could handle. We felt that an article, once accepted, should receive fairly early publication. It was a wrong system that allowed a paper read on January 1, 1930, to be published in the January, 1931, issue of a journal. We began to receive letters pointedly asking "when will my article be published?" We began to lose sleep on account of a plethora of material. There was only one solution to the problem. Enlarge the journal. We doubled the size.

We increased the reading matter from

100 to 200 pages. In fact we had been publishing about 140 pages monthly and during the past year have gone far in excess of our 200 pages a month allotment.

Some of our friends asked if it would not have been easier to have rejected most of the material offered and kept to the smaller size. This brings up a debatable subject. When we inquired what type of article we should exclude the answer usually was "all except the most interesting." "Interesting" articles were usually what that individual specialized in. But if one published nothing but gynecological or urological or neurological articles it would become a class journal and of interest only to a selected few.

The increase in size offered greater opportunities for a wider range of material. In each issue there was sure to be something of interest to everyone. That we were on the right track has been proved by the steadily increasing circulation. To-day THE AMERICAN JOURNAL OF SURGERY has the second largest paid circulation of any surgical journal in the country, probably in the world.

And so we have tried to interest the majority. We have attempted to offer articles that have a decided practical slant. No one reads the journal from cover to cover each month. But if each month a reader finds some things worth while and of value to him, things he can use in his everyday work, then an ideal state has been approached. One reader will be bored by an article for which any editor would give his celestial right hand. However, the same reader will discover an important point in a modest, almost commonplace case report.

And while we are rambling on in this personal style let us answer at this time many points made by those with whom we come in personal contact and by those with whom we have corresponded. Many ask why we do not publish *only* articles by nationally known workers. Names! Perhaps such a policy might be good "box-office" tactics for lay publications,

but science is a temple with many open doors and anyone may enter provided that he will knock and can deliver the goods. As a rule the man with an established reputation can be depended upon to score but it is also true that he is human and, at times, capable of offering a rehash of a subject done to death. Thus we have published the effort of many *as yet* unknown surgeons. We accepted their offerings because they had something to say that was worth while.

Before we finally reach what we started out to say perhaps it may be well to explain certain things. We have been asked why we no longer are the official organ for societies, etc. This was a deliberate move on our part. Every so often there arrived a large package of manuscripts. They were the transactions of the "last meeting." An article or two would be above par. The rest were just "those things." Knowing how programs are arranged we could hear a president or chairman say, "Dr. Blank is coming on from New Orleans or Chicago or Baltimore to read a paper. I want you to read a short paper as a curtain riser. Something not too long. Have a few lantern slides. I'm getting a couple of the boys to present case reports. Of course you can do it. Do the thing you gave last year. A short paper by you and a couple of case reports will round out the program." It became embarrassing to have to spot these fillers only to have to return them. It caused "hard feelings." It led to correspondence. We had to be diplomatic. We wished we could bluntly say the stuff was terrible and let it go at that. It reacted on our nervous system.

And then we found out another amazing fact. There *are* cliques! Play with one clique and the other clique will have nothing to do with you. Politics! Letters! Explanations! Wheels within wheels. Overboard with all of it!

So with no regrets, we decided to be independent! Just because a thing was read "at the last meeting" meant nothing to us.

We had other criteria: was it good, interesting, authentic; did it teach something or emphasize an important point?

We started this to mull over the journal during 1930. We have wandered so far afield we will have to leave much of what we were going to say to another time. However, we look back with real pride to Edward M. Livingston's serial, "A Clinical Study of the Abdominal Cavity and Peritoneum." We read the manuscript a year ago last August at the seaside. Sitting tailor fashion on the sand under a gay umbrella we found we were reading it as we would have read an interesting work dealing with history or biography. The writing flowed. We did not have to command the mind to plug through it. We knew we had something solid to offer our readers. As a reward some of the most famous American surgeons have said that it is a real contribution to surgical literature. It is sure to live and find a permanent place among surgical publications. In the spring it will be brought out in book form. To the twelve installments will be added a few additional chapters we did not have the space to include. In every sense the book offered will be a second edition. It will be a book necessary to the medical student and invaluable to the practicing surgeon. We congratulate Livingston on a splendid piece of work.

We would like to tell of other high spots of 1930. We were the first in this country to publish the new method in intravenous pyelography . . . an article on Uroselectan by Swick. Last month Dr. Case reviewed the articles on Radiology appearing in 1930 in THE AMERICAN JOURNAL OF SURGERY, so we will not duplicate his work, but will simply state that many excellent articles are scheduled to appear in 1931.

Another book will be offered our readers in serial form during the year. We read the manuscript and knew before we had gone far that we had a valuable monograph. We wired the publisher, then in the West, to arrange for its publication. It was new, different, practical, sound, well written. We refer to Dr. Cutting's "Principles of Preoperative and Post-Operative Treatment." In this issue appears the first installment of this work. We urge every reader to follow it carefully. We believe a modern surgical journal should offer something throughout the year in a truly educational, almost textbook manner, in addition to the usual shorter articles, and in fulfilling this aim we consider ourselves and our readers fortunate in having Dr. Cutting's book as a part of the journal.

The material on hand is of an exceptionally high grade. 1931 is destined to be far above the average. We are open to suggestions. We welcome them. We want a journal that is read and found valuable by all surgeons.

We wish to take this opportunity to express our appreciation and sincere thanks to the many who have aided us in the past. Without them and their earnest help and practical suggestions we could not have carried on.

We wish to you, one and all, a Happy, Healthy and Prosperous 1931. T. S. W.

THE ROENTGENOLOGIC VISIBILITY OF THE NORMAL GALL BLADDER

THE demonstration in the roentgenogram of the actual outline of the gall bladder shadow was first called to the attention of radiologists in cases where gallstones were clearly delineated. A number of American authors, especially A. W. George, attributed considerable importance to these faint ovoid or globular shadows in the right upper quadrant which corresponded in size, shape and position to the gall bladder, especially because in several operative cases where a large

hydrops of the gall bladder had been found, re-examination of the x-ray films showed what seemed to be the clear outline of the enlarged gall bladder, which because of its size had been mistaken for the kidney. It, therefore, appealed to Dr. George and others that under certain conditions the gall bladder itself was visible, and they soon observed that in cases coming to operation where the gall bladder had been outlined on the film some sort of pathology was invariably found in the gall bladder itself. Dr. George argued that with the present technique the gall bladder shadow might be produced on the x-ray film, if some change from the normal had altered its density, and he finally reached the definite conclusion that if the shadow of the gall bladder was seen on the x-ray film, it was an indication that the gall bladder was pathological. It is significant that Dr. George stated in 1922, "doubtless the time will come when with improved technique one will be enabled to visualize a normal gall bladder," thus foretelling the discovery made by Graham and his colleagues in 1924.

However, there were many who did not agree with Dr. George in his conclusion that the gall bladder when visualized in the x-ray film was always pathological. In the first place, it should be noted that cases come to surgery, not only and not chiefly because of the x-ray evidence, but because of pathological manifestations giving rise to subjective and objective findings which really confirm the surgeon in his decision to operate. We, therefore, believe a considerable factor of error enters into the apparent statistical confirmation of the cases referred by Dr. George; in other words, a certain number of pathological gall bladders were operated upon, and, because in a number of them the apparent outline of the gall bladder was distinguished, the conclusion was reached that to see the outline of the gall bladder on the film meant that the gall bladder was pathological.

Of course, the introduction of Graham's method has permitted us to check on these shadows. Very often we have been surprised to find that the apparent gall bladder shadow must have been due to something else, because the gall bladder as visualized by Graham's method did not coincide with the suspected shadow. The writer of this editorial suggested[1] that many of these shadows which were at first thought to be gall bladder shadows were later proved to be due to something else. Some of them were due to the duodenum seen in profile; others to one of the lobes of the liver which are sometimes present, having more or less the size and shape of the gall bladder.

This subject was recently discussed before the Société de Radiologie Médicale de France.[2] Dr. Ledoux-Lebard, in charge of the course of radiology, University of Paris, said that up to the present time it had been generally considered that the fact of visualizing the gall bladder on films made without previous preparation of the patient warranted a strong assumption in favor of the existence of a pathological state of the walls of this organ or a modification of its contents. Ledoux-Lebard now thinks that the moment has arrived to criticize and revise this opinion in view of the enormous progress in technique realized in the last five years.

Under modern technical conditions it is justified to believe that a mass of liquid, amounting to 20, 30 or 40 c.c., such as is generally represented by the normal gall bladder full of bile, is more than sufficient to cast a shadow recognizable in good roentgenograms of patients of average weight or less. Multiple control operations carried out by the surgical service of Professor Gosset have confirmed this opinion, and Ledoux-Lebard now believes it is important to warn radiologists against interpretations which subject them to such great risk of being inexact.

[1] Case, J. T. Some pseudovesicular shadows and other pitfalls in gall bladder roentgenology. Radiol., 2: 1, 1924.

[2] Ledoux-Lebard, M. R. La Visibilite de la vesicule biliare normal. Bull. et mém. Soc. de radiol. méd. de France, 170: 243, 1930.

The writer of this editorial in 1927 suggested that the ovoid pseudovesicular shadow so often seen in the right upper quadrant may be due in most instances to the shadow of the duodenal bulb and the upper portion of the second part of the duodenum itself, where it passes posteriorly to make the beginning of the duodenal curve. The average roentgenogram of the abdominal region shows the psoas muscles and even the lumbar muscles, and a number of other soft tissue outlines which can be delineated on a well exposed film. It is reasonable to suppose that at times we may see a rounded shadow just below the inferior border of the liver, due to the piled up density of a segment of the duodenum recorded in profile. This opinion is sanctioned by the fact that very often we see within this ovoid shadow a bolus of gas, representing gas within the duodenum. The pyloric end of the stomach may cause a pseudovesicular shadow, although it is larger than one would expect for the outline of the gall bladder. As already mentioned a shadow simulating that of the gall bladder may be caused by one of the lobes of the liver.

With rare exceptions the writer deems it impossible to identify with surety any right upper quadrant rounded or ovoid shadow as due to the gall bladder until the gall bladder has been visualized by the injection or ingestion of dye by the Graham-Cole method. In the direct examination of the gall bladder without the aid of cholecystography, a small rounded shadow in the right upper quadrant, distinctly not caused by the inferior border of the liver or by the kidney, is in all probability due to something else than the gall bladder.   JAMES T. CASE.

JAKOB BENIGNUS WINSLOW

[1669-1760]
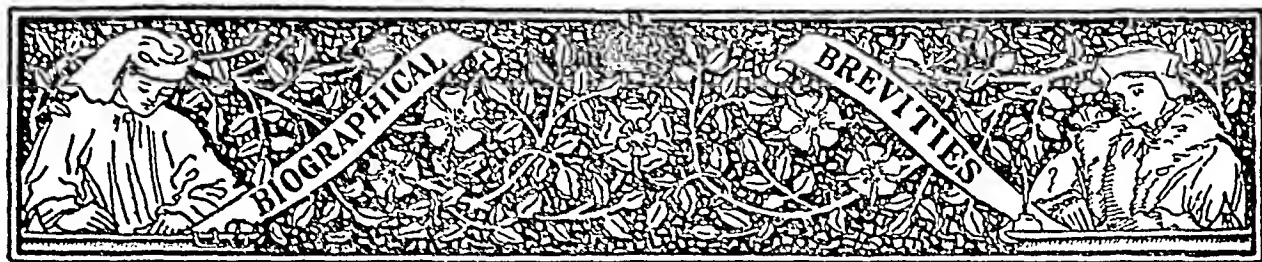
"FORAMEN OF WINSLOW"

JAKOB BENIGNUS WINSLOW was born at Odeuse, Denmark, April 2, 1669. His father and grandfather were Lutheran ministers. Thus, it was natural that Winslow should study for the ministry. But he turned from this and began his medical studies. In 1697 he engaged in pre-medical study in Holland. A year later he continued his studies in Paris and became a student of the French anatomist Duverney, who encouraged him to direct his work especially toward anatomy. In 1702 he matriculated in the University of Paris, from which he received his degree, Doctor of Medicine, in 1705. Two years later he was presented to the Royal Academy of Sciences by Duverney. So great was Winslow's ability and so deep was Duverney's faith in this ability that he often allowed Winslow to conduct lectures on Anatomy and Surgery at the Jardin du Roi. After Duverney died the chair at the Royal Garden was filled by Hunault. Later Winslow occupied it for many years.

When Winslow began to study medicine he spent his unoccupied time with theological problems and went deep into the study of philosophy. Whether as a result he turned Catholic we cannot venture. But he did accept the Catholic faith and as a result was disinherited by his family.

When he began the study of medicine he was granted a pension by the Government of Denmark, in order "that the country might not be without participation in the glory of advancing the progress of anatomical knowledge." At a later date the Bishop of Meaux gave him financial aid. The Bishop died one year prior to Winslow's graduation so he sought the faculty of the University of Paris for financial assistance, which faculty "was not deaf to his pleas but even paid all his expenses for the rest of his course."

Winslow is credited as having been the first to use the term omentum in its present sense. To the casual student the original words of Winslow are hard to comprehend. This is because he used the term "lesser omentum" in a different sense from what is used at the present time. Winslow's "lesser omentum" is the lesser peritoneal cavity of the present day.

The source of the eponym, "Foramen of Winslow" is in "Exposition anatomique de la structure du corps humain," Paris, 1732, 2:170, 352–365.

Winslow demonstrated the communications of the foramen, now bearing his name, by inserting a quill or pipe into this opening, and then blowing air through the quill. He discovered the air distended the greater omentum.

Winslow published several books and papers between the years 1711 and 1742. Other eponyms bear his name: Winslow's ligament and Winslow's stars. He did much to systematize the anatomical knowledge of his day.

He lived to the old age of ninety-one years, departing this life on April 3, 1760.

T. S. W.
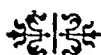
[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

SCIENCE AND CONSCIENCE IN SURGERY*

M. Le Professeur J. L. Faure

PARIS, FRANCE

THE *Revue de Chirurgie†* presented to its readers the speech *in extenso* given by Professor J. L. Faure on "Science and Conscience in Surgery" at the inauguration of the *Medical Journals of Brussels* (June 28, 1930), in the presence of Their Majesties, the King and Queen of the Belgians. Permission was granted by the Publishers of the *Revue de Chirurgie* to THE AMERICAN JOURNAL OF SURGERY for American publication.

Sire, Madame;

May I be permitted to greet you both with the homage which is due you.

For you, both of you, are the living symbol of those great memories of grief and glory which will never be effaced from the history of the Belgian people.

You, Sire, were the Man of Destiny. For it was you, it was you alone, who, in the sublime moment when you drew the Sword of Justice, changed the course of history. For it was you, you alone, who, by delaying for a few days the profane invasion, allowed the great soldiers of Joffre to draw themselves up on the Marne and to win the immortal battle.

And the sons of France will never forget that it is to you that they owe the fact that they still have a country.

And you, Madame, beside your King "sans peur et sans reproche," knew how to be a Queen! You knew, in the most tragic hours of history, how to raise yourself as high as he, by your courage as well as by your devotion.

After trials without number you came back together, among the flags waving in the breeze of deliverance, to your cities transformed by the colors of the fatherland. United in the memory of men as you were in life, you will remain forever the King and Queen of Victory!

Your Excellencies, ladies and gentlemen:

One of the great emotions of my life, and perhaps its greatest honor, will be to have been chosen twice to speak under such solemn circumstances. Ten years ago these Journals were being born, still uncertain of the future and of the great fortune which they were going to find. Today, after ten years of uninterrupted success, doctors from all over the world have come to give them a universal consecration.

Ten years have passed, pushing little by little into the shade, still crossed by sparks of sad memory, everything which at that time was moving our broken hearts,

† The translation is by Grosvenor Wainwright, of Scranton, Pa. Ed.

* Submitted for publication November 20, 1930.

when we were just emerging from the greatest drama of history.

And here we are met again, we who come from France, in the happiness of seeing, as in a sort of spiritual renaissance and youthful joy, noble and fraternal Belgium, she who was side by side with us in martyrdom and in glory, celebrate enthusiastically the youth of her one hundred years of age.

No one can be astonished if on a day like this a surgeon should find it natural to speak of surgery.

For half a century, since it lost that gravity which formerly surrounded it with an atmosphere of grief, it is today a part of our life. There is no family which has not seen it enter the home, and the hecatomb of the Great War did more for the diffusion of its benefits than one hundred years of peace.

But although it was given to millions of soldiers and thousands of nurses to witness its powers, very rare indeed are those who are able to seize the profound impressions and moral discipline which make of this magnificent and at the same time terrible art the one which most of all subjects to the hardest trials the hearts of men who consecrate their lives to it.

At any instant in our vocation and in our assiduous labors the obscure forces which shape our destiny may place upon us heartbreaking problems, perhaps even the redoubtable task of deciding at any minute upon the life and death of those whom chance has placed in our hands.

Without doubt there is in the souls of all men a force of habit, a power of adaptation to circumstances, when these circumstances are met every day, which bring it about that our impressions are attenuated and most of our daily decisions do not move us, as they should do, to the deepest fibers of our hearts.

When, followed by our pupils, we pass slowly before the beds of our patients, we seem no longer to realize the formidable power which we hold in our hands, and when we pronounce in a voice which no emotion has altered the few words, cutting as the scythe, which decide an operation, we know nevertheless that these few words, falling in silence like the sentence of a judge, can precipitate a living being into death and irrevocably throw a human existence into the scales of destiny.

What power indeed! What almighty power! And what, compared to ours, is the judgment of men?

Under the majestic vaults, of the tribunes and the courtrooms, in the red of purple robes and the white of ermine, in the pentup anguish of the crowd is meted out the justice of men!

In the bare halls of our hospitals, among the beds where lie, silent and resigned, so many victims of human misery, a few words falling from our lips will decide their fate, without appeal and without remission, like the justice of God!

May the force of habit not blind us to the grandeur of our mission! It is our duty to be conscious of it and to reflect deeply on the responsbility which is imposed upon us by a power without limits!

We have not the right to undertake lightheartedly the practice of this beneficent and redoubtable surgery if we do not feel strong enough to master it before taking the responsibility of those irreparable acts, surgical operations. For there is not one of them which does not carry with it the possibility of death. And he who puts his confidence in us and abandons himself to our hands is like the traveller lost in a storm, under a sky afire with lightning, and thunder over his head.

Surgery is then full of grave responsibilities which we cannot support without having done all that is necessary to fit us to perform them well.

And they are long studies! Anatomy first, anatomy which many seem to scorn, but which alone can give to him who knows it well that assurance indispensible to every surgeon worthy of the name, who knows what he is doing, who knows where he is going, and who works with that profound sense of security which can come

only from a faultless knowledge of all the secrets of the human body.

After anatomy what is necessary to know above everything else is the science of diagnosis. For this, all that one can read in books hardly counts compared with experience. What counts above all is the personal inspiration and instinctive impressions which proceed from an artistic sense much more than from the rigid laws of a determined science.

Let us seek constantly, let us seek carefully for that sovereign quality in the surgeon, operative science. For it is to this, to its application in certain dreadful and often tragic hours, that our art owes its most glorious triumphs. Everything converges, everything ought to converge, on operative procedure. In the end what avail the compilations in books and the lessons in amphitheaters, on the day when it is necessary to take the responsibility of a difficult operation? It is at the operating table that one learns the art of operating. It is in working next to a master, in assisting him in his interventions, in participating with him in his delicate maneuvers, which are well seen only from near by, in coordinating one's movements with the master's deft touch, that it is possible to intiate oneself little by little in the ever-new difficulties of an operation and to feel one day the right to undertake such an operation on one's own responsibility.

It is here, it is in the art of operating, that enter above everything else the personal qualities of the surgeon. For it is not sufficient to have aided a master for several years, to have seen, to have worked, to have reflected; it is not sufficient finally to know; it is necessary rather to acquire, if a generous nature has not accorded it, that ensemble of qualities which constitute the operative art, made up of method, of reason, and of good sense, much more than of cleverness. It is these qualities which constitute the personal mark of each operator and which bring it about that between two surgeons who cure their

patients equally well there can be as much difference as there is between a great and inspired artist and one whose chisel, even if faultless, will never be able to make the spirit of life glow in the whiteness of inanimate marble.

And finally there is something which dominates all. There is something which in the effort of a magnificent inspiration has made the operator evolve from his very soul some new means of marshalling the forces of life against the powers of death. Here is not only the good workman who disappears when his task is ended. Here is not only the perfect artist whose gesture vanishes to leave only a memory. Here is the master whose enduring work will defy the havoc of time!

If the masters, if the surgeons whose names are known to all, draw to the amphitheaters and to the operating rooms students, disciples, other surgeons, from the most diverse and remote countries, in order to hear their teachings and to see the work of their hands, still these masters cannot do all. It is requisite, it is necessary that the innumerable operations which are performed every day be entrusted to a sufficient number of surgeons. But it is also necessary that these surgeons be capable of undertaking them and worthy of the confidence which one is obliged to place in them.

And here lies the great problem at the present moment, with the masters, with the surgeons qualified by their work or by the choice of their peers, during a lifetime of difficult tests where sometimes legitimate hopes are dashed, work, students, internes, assistants, who absorb from their masters the necessary discipline after years of hard work.

Indeed I am not one of those who think that one can not find valuable men outside those who are consecrated officially by examinations and competitions! No! Talent is a marvellous flower which can blossom freely in the disorder of the forest as well as in the severe ordering of a park. But talent is rare and the practice of surgery

claims innumerable resources in men from whom one can ask neither genius nor talent, which are the privileges of a few. But from these men one has the right to demand an exact science, a sufficient experience, and that probity of mind necessary to the practice of an art which confers super-human rights.

This is a grave question, and one which preoccupies many minds. The relative harmlessness of surgery, and also the implacable necessity of its diffusion during the War, have put it into the hands of a great number of men, and today every doctor, armed with his diploma, which confers on him every right, can, without ever having held a bistoury, open a clinic and make himself a improvised surgeon on occasion.

If I say this here, it is because it happens not only in France, and because these things must be known and known by all, for everyone some day or other may have need of this surgery which may be useful or harmful, fatal or beneficent, according to the man who practices it. A certain number of surgeons, disturbed by this situation, have believed it their duty to bring it before the Academy of Medicine and ask that the habitual practice of surgery be not authorized unless, aside from the present diploma, the future surgeon possess a certificate of competence in surgery, delivered for example to all those who beside their higher examinations, shall have successfully passed three years in a surgical service.

Troubles of the same kind, if I am not mistaken, have appeared in the Royal Academy of Belgium.

This reasonable and moderate demand has been rejected by the Academy of Medicine which satisfied itself with accepting an optional certificate, changing nothing in the present state of affairs. The Academy, I am not afraid to say, has given in this case a very poor idea of its sense of responsibilities. It did not wish to diminish the value of a diploma created more than a century ago, at a time when surgery, or at least surgery such as we understand it today, did not exist, so to speak. It confined itself to some few urgent interventions, which no longer count, when by thousands and thousands and tens of thousands, in a single country like France, countless patients come every year under the surgeon's knife. How many in that immense crowd are led by the blind chances of fate into the hands of a man of great experience, or into the hands of a beginner who knows little or nothing?

For the diploma in which they wish to place confidence includes nothing of surgery. It is worth exactly what the man who owns it is worth, and everyone knows that, by the force of things, every student gets it either by a happy chance or, still more often, by the laziness of the judges and by an excessive good nature.

Without doubt it is easy to say as they did at the Academy that they have not the right to deprive a doctor, armed with his diploma, of the power of practicing surgery when so many of them do it admirably. It is easy to show that frequently they have not only the right, but are duty-bound to do it, and there is no doctor out in the country who does not have a precise moral obligation to give his best assistance, by whatever means at hand, to an injured person whom he finds bleeding on the side of the road, an occurrence not rare today, when the folly of speed hurls to death so many voluntary victims. And how many other urgent cases there are, such as a violent hemorrhage, a strangulated hernia, a complicated fracture! Truly, we can never say enough good of these country doctors, who do honor to our profession, who labor day and night, in the burning sun of summer and in the snows of winter, who are sometimes the safeguard of an entire countryside, caring for children and old people, women in childbirth, and all those hurt in life. At the end of a career of fatigue and devotion they die in poverty, leaving to their sons only the honor of their name and the greatness of their example, while the bartender at

the corner by poisoning his fellowmen behind his bar gains the wherewithal to dower his daughters and retires on his savings.

It is no less certain that today when surgery, to be well done must be practiced in a place especially organized for the purpose, with facilities of transportation; such as the automobile, with clinics, which are spreading everywhere and are almost always directed by good men such as the former internes of our hospitals; it is no less certain, I repeat, that it is to these clinics that the immense majority of patients amenable to surgery must be directed. We must leave only the cases incapable of transportation and those too urgent to await the arrival of a surgeon to the country doctors, whatever their science and their knowledge, often deep, of all the branches of medicine may be.

These few reservations being made, it is permissible to find it deplorable, not to say senseless, that the lives of citizens be entrusted, in the name of the law, by virtue of the sovereign rights bestowed by his diploma, to a young man. Likewise it is senseless that a beginner, recently fortified by his thesis and never having opened a Whitlow, should serve his apprenticeship in surgery on his fellowmen. Who would be astonished that under these circumstances one at times sees certain bad practices? These would not be slow to disappear if the practice of surgery were confined to men capable of exercising it with all their science and all their experience.

For science is not enough. It is only a powerful arm, which can become disastrous if not directed by a more powerful force which rises from the depths of our souls and is called conscience.

It is in fact our conscience alone which must inspire us in that fleeting instant when we take the step from which there is no appeal, to play the supreme part on which a human life depends. And it is again our conscience alone which upholds us in the dizziness of the action which at times seizes us, lifting us above ourselves in the

magnificient exaltation of certain operations in the course of which, like the eagle of the high peaks, we feel ourselves rise toward the summits of art!

The habit of playing each day with the lives of men must not make us lose sight of the tremendous power with which we are armed, and which has no equal in this world, except that of a military commander, whose order in the drama of battle may send thousands of soldiers to death or to victory. We ourselves have responsibilities no less extensive and perhaps even greater, when from the height of some resounding tribune we give, for example, advice on some doctrine of universal application, whose verity has been demonstrated by our experience, but which is none the less combatted by sincere men, fixed in their convictions or in their habits.

The scientific journals carry our discussion to the entire world where these contradictory counsels are followed or are combatted by all those who have confidence in us. So that a word spoken here may cause innumerable beings, some thousands of leagues from here, to live or to die, beings who will never know that they owe their lives to us, or that it is we who are the cause of their deaths.

Ah! Let us never speak lightly of these great questions, like some of those I have seen come up, whose solution can save human lives by the thousands every year.

And what evil to humanity would his contradictors have done to Pasteur, that great victor of the greatest battle of all time past and of all time to come, against sickness and against death, if their passionate attacks had, as they wished, torn from the great man the confidence which his faith in the truth of his cause gave him.

Peace to the memory of those men who, had they won, would have deserved the curses of humanity!

"I command or I say nothing," said Napoleon.

Let us take example from this great man.

Let us affirm only that about which we are sure, or let us say nothing.

But, always, let us appeal to something higher than our science, than our art, than our experience! And when a doubt comes to blight our spirit, let us invoke that which we feel to be the most pure in us, the most profound, the most sacred, the most inflexible: let us invoke our conscience.

This is not only a great word, one of those powerful and dominating words which, when one pronounces them bring to our minds a whole world of sentiment and stir all that is most noble in the hearts of men; it is a living reality for those who, like us, find themselves face to face at all times with the most distressing problems of duty.

For we are only men, fallible as all men, subject to uncertainity, exposed to error, sometimes lost in the shadows, and who, nevertheless, meet the duty of having to choose between the uncertain roads of life and death.

Ah! our duty is doubtless dazzling. Let us listen to the sublime rule: "Do unto others as you would have them do unto you!" and let us everywhere and always, adopt decisions which most conform to the interest of those who turn to us! But that is only a vain word, one of those sonorous words which are lost in the night. For the problem which is raised is precisely, "What is the decision most conforming to that endangered interest?" In fighting for a rapid cure, in fighting for life, the possibility is always present. And would we be discussing it thus if the shadow of death were not hovering over all our deeds?

Here is the real problem, one which is raised every day. And this is why at the moment of taking the resolution that must be taken, in the presence of him who comes to us and whose anxious look seeks to read our thought, we feel obscurely struggling in our soul the powerful reasons for acting, and those which, sometimes no less strong, counsel us to abstain. But we must choose, nevertheless, fully conscious that on that decision hangs the life of a man, a child, a young woman, already prepared to give another life. An irreparable condition is there, hidden in the shadows. It will necessarily be revealed by our decision. We shall know tomorrow.

Duty! duty! powerful word, sublime word, and one which is enough, as we have seen in tragic hours, to transport men to the exaltation of sacrifice. Duty, we must ask to lead and inspire us.

It is no doubt easier to sneak away and bury oneself than to throw oneself into the attack. But we know also that it is a serious thing to do nothing, and that a too comfortable abstention is very often more dangerous than the thing the weak and powerless call temerity.

That is why we, Surgeons, we who know the magnificent resources of our art, owe our trust to it. Let us have the creed of action. For it is through action that we triumph and that we are stronger than death.

When surgery has given what it has given, when it has rendered what it has rendered by its last fifty years of service, when it has furnished by its incalculable benefits the dazzling proofs of its value, let us, we who know, we who *can*, raise our souls above ever-easy slander, above calumny, above the too common accusations of incompetents or of the jealous, above the legitimate grief which undeserved misfortunes have provoked, since we have with us the impenetrable sanctuary of our conscience. And during those times when we are exposed to the evil-doing of certain laws, and to the ignorance of those who apply them, it is something to be able to find in ourselves this inviolable refuge which is above the justice of men and whose serenity the iniquity of certain legal decisions will not be able to disturb.

For it is not in legal codes or courtrooms, it is not in the chance decisions of magistrates, that we will find the sanctions of all the acts of our lives. It is in the deep ever-recurring joys which the good that we do brings to us, and it is also, alas, in the bitterness of grief-stricken hours which break our hearts, at the bedsides of the dying, whom we have not been able to save, and whom we are sometimes conscious of having hurried to death.

And where is he then, he who can set himself up as judge in all good faith? Outside of some rules whose absolute certainty has made a few incontrovertible laws, like those of asepsis, the negligence of which may be classed as a real crime; aside from a few rules which fall under the control of simple good sense, where is he, I repeat, who can constitute himself a judge. Who will arise to say to any one of us: "You are guilty because you have not given proof of a superior cleverness, of an unshakeable presence of mind, of an iron resistance to fatigue, qualities which are given to so small a number! You are guilty for not having been the faultless workman at your task, for not having felt that on the precise movement of your hands, on the sometimes instant action, depended the health or the illness of your patient, his happiness or unhappiness, his life or his death! You are guilty for not being the perfect man, when there is no perfection in this world." When will it be understood that there can never be either precise rules, or absolute laws, or even a common measure for the surgeon absorbed in the difficulties of his task?

For there is no common measure between the man who feels the lofty inspiration and sudden light seething and pulsing in his heart and the other, the perfect technician, the faultless operator, like those one meets in great numbers in countries of advanced medical education, but who remains incapable of raising himself above what he has faithfully learned, of feeling the divine spark burst forth.

For if you refuse to that man who bears in himself the power of the Master, the right to follow his inspiration or even his genius, who then will lead out of the rut the great art which we all serve and launch it into new paths? For fifty years it has been permitted to us to walk these well-known paths while the miracles of contemporary surgery have spread beyond limits of which our masters did not dream.

Soon it will be a half century that I have lived in the hospitals. For forty years I have breathed each day in a sort of spiritual communion, with the sick and those operated upon, with those who suffer to live and those who suffer to die.

When I see them ranged before me, in the evening of my memories, it is a people in a confused tumult which rises in my memory and whose vision fills me with pride and melancholy at the same time.

Poor lost sick children, defenseless and without understanding! Old men whom inexorable death already grasps! Young women condemned by the unjust travail of maternity! And you especially, you who were the grievous obsession of our days and nights for four years, young soldiers, sublime young men, whom the fatal accidents of history have thrown into the tumult of battle! You the heroes, you the martyrs of the immense hecatomb, whom I have seen lying in countless numbers in all the hospitals at the front, where one heard dimly the wings of death hovering above, but where so many of you found life again. What pains, what miseries, what unjust sufferings, how many innocent victims of a pitiless fate!

And now we are in the days when we see the last years coming, when we feel the hour approaching to lay down, in our turn, the arms which we have used for so long to drive back death.

Let us cast a glance backward into the mist of the past, so that our life work may unroll before our eyes. How many dead, how many dead! Their image now dim, now bright, alas, draws itself up before us. Many of them would perhaps still be living on this earth, if our judgment, instead of letting itself be guided by hope, had abandoned them to fate, and had refused to lead them to the table of blood, which for them was the altar of sacrifice, when for so many others it is the threshold of resurrection.

May our souls remain serene and our hearts firm before the image of these dead. For our souls were pure and our hearts sincere when we placed on them the predes-

tined hands which sought for health and found only death.

Innocent victims of the Fate which hovers over the world, these dead, these poor dead, have not died in vain. Just as much as the soldiers fallen in battle, they are the obscure artisans of the victory, and their unrecognized sacrifice finds its recompense in the health and joy of those saved.

How many dead! How many dead! How many living too . . . It is a whole people that rises. It is a whole world of living people who are giving, and will continue to give, life to others.

And there is that stronger, more intimate and deeper joy, for those who, in the meditations of their nights, or in the feverish inspiration of some moving moment have forged some new and decisive weapon against suffering and death. This will survive them and will prolong into the future their beneficent activity and will make the work of their brains a living thing, when their fame shall have disappeared and their name shall be stricken from the memory of men.

Gather together, gather together then,

ye phantoms who have disappeared, yet who are living at the present moment, ye children of the future who people our spirits with your shadows and images; ye are the faithful companions of our memories and of our dreams, ye are our despair, our pride, and our hope!

Forgive us, ye dead of the past, fallen on the field of honor. Ye are fallen in the hard battle which we fought to preserve life. Console us, countless multitude of the living, multitude of those whom we have saved, who very often appreciate us no longer. Console us, children of the future; although ye will not appreciate it, we gave life back to those who will give it to you. Gather together, dead and living. Let your silent images rise before us. And before the silent throng of all those who owe and will owe their lives to us, as well as those whom we have hastened into death, let the voice of our conscience mount into the silence and come to murmur to the echoes of our souls that the work of our lives has not been in vain, that we will have passed over the earth like the plowman who fertilizes the plain, scattering to the four winds of heaven the seed of future harvests.

BOOK REVIEWS

PIERSOL'S HUMAN ANATOMY. Including Structure and Development and Practical Considerations. Ed. 9, Revised under the Supervision of G. Carl Huber, M.D., SC.D, 2124 pp., 1734 illus., of which 1522 are original and 460 are in color. Phila., J. B. Lippincott Co., 1930.

A truly American textbook and a good one! The reviewer well remembers when a new star burst upon the Anatomical firmament in 1907 and it is with a feeling of sadness that it is noted that of the five men who collaborated at that time only one is still living. Each of them, however, would be proud of this ninth edition of what has, in truth, become a classic. Dr. G. Carl Huber, Professor of Anatomy at the University of Michigan, edits this edition

and in the Preface assumes full responsibility, though he has had the able assistance of Drs. E. L. Eliason, E. P. Pendergrass, R. E. McCotter, E. C. Crosby, L. H. Strong and J. F. Huber. A consistent and uniform B. N. A. Nomenclature has been adopted and the newer Neuro Anatomy has been included. In order to make one volume of over 2100 pages thin paper has had to be used, and for this reason the illustrations, of which there are over 1700, do not show up as well as they might. However, as a student's text, the new Piersol may be recommended without reservation.

HISTORY OF MEDICINE IN NEBRASKA. By Albert F. Tyler, M.D., Editor, Ella F. Auerbach, Compiler. 670 pp. Illus. Omaha, Magic City Printing Co., 1928.

An interesting work particularly, of course, locally. However, books of this kind, giving the story of medicine in important states and cities, telling of the pioneers and of the men who have assisted in the development of medical science in that community, with the story of the conditions faced and of the medical schools and hospitals founded, make important source material for medical historians and must furnish a great incentive to the younger physicians of the community.

It is interesting to note that in the story of Nebraska, the point is made by the Editor that "There are still present in our midst two surgeons, J. E. Summers and A. F. Jonas, who were the first in Nebraska educated after aseptic methods were introduced. When they came, the late Victor Coffman was doing ovariatomies, wearing flannel sleevelets over his shirtsleeves to keep them from getting soiled. Tracheotomies were a frequent emergency operation in diphtheria cases because of the lack of antitoxin." It is perhaps well to be reminded in this manner that the proverbial "good old days" included the days before asepsis and that they are so close to us, that there are men active in surgery today who practiced at that time.

The description of the publications issued from Nebraska makes interesting reading, as is the story of the development of hospitals, and medical schools.

All in all, it is a fascinating book and one that we would like to see duplicated for every state in the Union.

LEGAL MEDICINE AND TOXICOLOGY. By Ralph W. Webster, M.D., PH.D. 862 pp., 4 plates, 48 illus. Phila., Saunders, 1930.

There has been felt a distinct need for a one-volume, authoritative and up-to-date work on Legal Medicine and Toxicology. This is met by Dr. Webster's book which will be found valuable for reference by every practicing physician and surgeon. Concise and to the point, it covers an unusual amount of ground and will answer most questions in sufficient detail for the average physician's use. Extensive references make it easy to get further information without undue effort. The first chapter on "Legal Rights and Obligations of Physicians" will probably be the most used in the entire book and it is alone worth the price of the volume.

SELECTED READINGS IN THE HISTORY OF PHYSIOLOGY. Ed. by John Farquhar Fulton, M.D. 337 pp., 61 illus. Springfield, Charles C. Thomas, 1930.

In this book are selections from the writings of those who have contributed to the development of Physiology, beginning with quotations from Galen and Aristotle, through such modern authors as Cannon, Pavlov, and Cushing. The author has a flare for selecting from an author's work just that material that presents his viewpoint best. Not intended as a History of Physiology, this book actually gives in concise and readable form the source material forming the basis of such a History.

No better argument for the presentation of material of this kind to medical students is known to the reviewer than the author's suggestion to let the student "realize that men as young as himself have made important contributions: that de Graaf at twenty-three years of age devised the first pancreatic fistula; that Helmholtz at twenty-four measured for the first time the heat production of frog muscle; that Johannes Müller at twenty-five had enunciated the principle of specific nerve energies. Let him discover that simple facts were once hidden in a fog of faulty observation and faulty reasoning, and that it was sometimes the enquiring minds of students like himself that made matters clear."

DOSAGE TABLES FOR ROENTGEN THERAPY. By Professor Friedrich Voltz, Head of the Radiological Department, University Clinic for Women, Munich. London, Oxford Univ. Press, 1930.

This little volume is peculiarly valuable for the radiotherapist, but all too brief. Chapters one to four inclusive discuss the spreading, absorption, and scattering of x-rays, and the various factors that enter into the estimation of the x-ray dosage, including the physical dose, the biological dose, the dose quotient, the percentage deep dose, the effective dose, the practical dose, and the absolute unit of dosage. The various methods of measurement are also briefly set forth. Then follow three groups of tables: 1, tables of intensity, time, and space factors; 2, tables of intensity and absorption factors; 3, tables of practical doses. The final chapter relates to the biological and to the physical calibrations.

This book is a translation from the second German edition, with the object of assisting the practical radiologist to estimate dosages without the necessity of long physical measurements and repeated calculation. It is, of course, devoted entirely to the estimation of physical quantities. The author explains that whatever stress is laid upon biological factors, it must always be remembered that the biological effect of x-rays can only be ascertained quantitatively by means of physical constants.

A CENTURY WITH NORFOLK NAVAL HOSPITAL, 1830–1930. A story of the oldest Naval Hospital, the Medical Department of the Navy, and the progress of Medicine through the past one hundred years. By Richard C. Holcomb, M.D., F.A.C.S. 543 pp., 42 illus., Portsmouth, Printcraft Publishing Co., 1930.

Combined with the story of the oldest Naval Hospital in the country, Dr. Holcomb has succeeded in giving us a splendid story of the rise and development of the Medical Department of the Navy. Having spent four years in charge of this Hospital, the author had access to the official records and his story is well documented. This work, which is a distinct contribution to the medical history of the United States, will be found fascinating, as well as instructive reading. As the author points out, "the story is inseparable from the chronicle of progress made in the medical sciences, which actuates the development of all hospitals, and being a Naval Hospital it is sensitive to those political and economic influences which have tended to develop the Navy." For this very reason, there are many interesting sidelights on the history of our country.

The illustrations are well chosen and the work is printed on a tinted paper, making a book that, besides its interest as a scientific and historical production, is a distinct typographical addition to any library.

PRIMER ON FRACTURES. Prepared by the Cooperative Committee on Fractures under Auspices of Section on Surgery, General and Abdominal, and Section on Orthopedic Surgery in cooperation with Department of Scientific Exhibit of the American Medical Association. 55 pp., Illus. Chicago, American Medical Association, 1930.

This book is made up of the folders prepared by the Cooperative Committee on Fractures for the demonstration of proper handling of fracture cases presented at the annual Scientific Exhibits of the American Medical Association since 1927. The Committee emphasizes the fact that "the purpose of the Primer is not to standardize treatment of fractures; it is to suggest what, in the opinion of the Cooperative Committee on Fractures, constitute acceptable methods of treatment." The illustrations consist of drawings of the actual Exhibits. This little work may be accepted as an authoritative statement of the best modern treatment for the handling of fractures.

MEDICAL ART CALENDAR FOR THE YEAR 1931. 28 pp., 27 illus. The Hague, J. Philip Kruseman, 1930.

No more desirable calendar for the physician's office can be imagined than this one of twenty-eight pages, each with a splendid reproduction of an old portrait, title-page or other item of interest in medical history. So well are these illustrations reproduced that they may well be kept to form an album. It will be a credit to any library on medical history.

The enterprise of the Dutch publisher in issuing this work with English, as well as with Dutch text, is to be commended. It is to be hoped that some enterprising American publisher will provide us some day with a similar calendar.

DIE THERAPIE DER WIENER SPEZIALÄRZTE. Bearbeitet von den Fachärzten Wiens. Herausgegeben von Dr. Otfried O. Fellner. Dritte, vermehrte und verbesserte Auflage. 678 pp. Berlin, Urban & Schwarzenberg, 1930.

This practical little book is of the old-fashioned type for practical quick reference. Since it is alphabetically arranged, one may quickly turn to it when in a quandary and in a few lines, or at most a page or so, obtain a short description of the most modern methods of treatment, at least, as carried out in Vienna. Each article is signed by a recognized authority. It should be kept on the office desk. The amount of material included in the less than 700 pages is really astounding. The publishers are to be congratulated on the fact that the type is large and distinct and that they have

not made the sacrifice that is so common now, of condensing material by the use of type that requires a magnifying glass to read.

LES PLEXUS CHOROIDES—ANATOMIE—PHYSIOLOGIE—PATHOLOGIE. By Mme. le Dr. Nathalie Zand. Preface by Professeur Roussy. Paris, Masson et Cie, 1930.

This is an exhaustive study and comprehensive discussion of the choroid plexuses from the standpoint of anatomy, physiology and pathology. The author subscribes to the modern theory by which the arachnoid is considered as a single connective membrane, intimately associated with the pia mater and forming the connective tissue stroma of the choroid plexuses. In her study of the function of the choroid plexuses, Dr. Zand discusses in detail the mechanism by which the cerebrospinal fluid is produced. There is still great controversy on this question. Physiologists and histophysiologists have a tendency to consider cerebrospinal fluid as a product of secretion, whilst chemists assimilate the choroid plexuses to a dialyzing membrane. Dr. Zand's researches lean strongly towards the first opinion. Particular attention is given to the study of the nature of the arachnoid cells found in the connective tissue stroma of the choroid plexuses. The epithelium covering the plexuses is said to differ morphologically and physiologically from that which lines the ependymal cavities. At the end is an important study of pathological conditions of the choroid plexuses and the ependyma, a good presentation of the various alterations of the choroid and ependymal epithelia associated with pathological conditions. This monograph contains so many new data on the choroid plexuses that the research worker, engaged in the exploration of this particular field, will find in it a wealth of information.

DIAGNOSTIC ET THERAPEUTIQUE ELECTRO-RADIOLOGIQUES des Affections du Systeme Nerveux (Electro-radiological Diagnosis and Treatment of Nervous Diseases). By A. Zimmern, Assoc. Prof., Faculty of Medicine of Paris and Dir. Medical Institute of Electro-Radiology, and J. A. Chavany, Chief of the Clinic of the Faculty of Medicine of Paris, Physician to the Municipal Institute of Electro-Radiology. 654 pp., 254 figs.; Paris, Masson et Cie, 1930.

The perusal of this well gotten up and attractive book reveals to how large a degree electrodiagnosis and radiology have contributed to the diagnosis and treatment of diseases of the nervous system.

The first part is devoted to electrodiagnosis of the motor nerves and of the muscles and of sensory disturbances.

The second part discusses radiological diagnosis of the bony envelope of the brain and spinal cord, and of the various clinical manifestations of nervous diseases. Abundant attention is given to encephalography and ventriculography, adequate credit being given to American and European physicians who have contributed to the development of this method.

The third part considers methods of treatment, faradic and galvanic currents, franklinization, high frequency current, diathermy, radiotherapy, radium therapy, and actinotherapy.

The remainder of the book is devoted to the diagnosis and therapy of the various affections of the nervous system. The final chapters are devoted to diseases of the muscles and paraneurological syndromes, such as exophthalmic goiter, tetany, spasmophilia, hysteria, etc., with a final brief note on neurasthenia.

The numerous illustrations, most of which are satisfactorily reproduced, add much to the value of this work. Because of the detail and completeness of the text and because of the inclusion of the most recent methods, this book should prove valuable both to the electroradiologist and to the professional neurologist. The general practitioner will find very much in this work to help him in the recognition of neurological difficulties of his patients.

MEDIZINISCHE PRAXIS Sammlung für Ärztliche Fortbildung. Herausgegeben von L. R. Grote, A. Fromme, K. Warnekros. Band VIII, GRUNDZÜGE DER NEUROCHIRURGIE von Prof. Dr. Med. Walter Lehmann. 209 pp., 23 illus., Dresden, Theodor Steinkopff, 1930.

An interesting, short and concise presentation of the Neurosurgery of today including a good bibliography for further reading. Of course, covering the entire subject of Neurosurgery in less than 200 pages, means that the book does just what its title indicates, presents merely an outline of the subject for rapid reference by the surgeon. This purpose has been well carried out.

PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

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PRINCIPLES OF PREOPERATIVE
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INTRODUCTION

I. The Importance of Preoperative and Postoperative Treatment in Surgery

THE history of surgery has been both long and honorable, and the tremendous advances of recent times made possible by the discoveries, first of general anesthesia by Crawford W. Long in 1842, and later of the rôle of bacteria in the production of infection, has placed the surgeon far out in the vanguard of the march of medical science. Modern surgery is now accomplished for the most part with a precision, expedition, and technical excellence which offers a serious challenge to the future if the established rate of advance is not to be retarded. Ingenious surgical instruments have been devised, operating-room technique has been perfected to such a point that the infected operative wound has become a sharp reproach to the surgeon and his assistants unless there be some legitimate source to which the infection can be traced, and operative procedures have been standardized to such an extent that the names of almost all the various surgical manipulations are constantly on the lips of the medical profession at large. Minute descriptions of these manipulations may be found duplicated again and again in readily accessible literature.

Under these circumstances it is not surprising that the practice of surgery presents no narrow confines and that many students of the healing art embrace the functions of the surgeon either habitually or from time to time, as the occasion arises, and in many cases do so with much benefit to the patient and with due credit to themselves. That such a happy outcome results only in possibly a large percentage of cases must be admitted, however, for there is a difference between the master surgeon and the neophyte which consists far less

in technical skill than in that intangible quality which is sometimes called "surgical judgment" for want of a better term and which includes not only (1) a practical knowledge, born of experience, of the possible complications and probable outcome of mechanical maneuvers as such, but also (2) so comprehensive a grasp of the fundamentals of medical science that its possessor instinctively and clearly visualizes both the abnormal and the normal bodily processes of his surgical patient, as well (3) as that divine gift of common sense so to adapt the treatment to the individual patient that under the particular conditions presented by the particular sick person the most benefit may accrue in the shortest time.

Measured by the standards inherent in this concept, operative technique is a distinctly subordinate part of the practice of surgery, whereas surgical diagnosis, together with that part of the treatment of surgical cases which is conducted outside the actual operating room, bulks correspondingly large. Many good treatises on surgical diagnosis are available, and indeed the fundamentals of the art are the basis of undergraduate surgical instruction everywhere and constitute the subject matter of many pages in all of the standard textbooks in surgery; but with rare exceptions, if the amount of space given to the consideration of the preoperative and postoperative care of surgical cases could be taken as a criterion of its importance, the assumption would inevitably force itself upon one that the surgeon, after making his diagnosis, ushers the patient into the operating room a sick man and soon thereafter removes him thence quite cured of his disease. Such a concept is, of course, highly absurd.

II. The Importance of Consideration for the Patient in Preoperative and Postoperative Treatment

No less a figure in modern surgery than Lord Berkley Moynihan has found it necessary to emphasize the axiomatic truth that the most important person present at any operative procedure is the patient himself. If the importance of con-

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sideration for the patient in surgery needs to be emphasized in connection with the conduct of affairs in the actual operating room, how much more important does it become in the more prolonged preoperative and postoperative periods?

Even in spite of the discouragingly high percentage of diagnostic failures reported in the current literature from time to time and in face of the fact that, especially in abdominal surgery, the human body proves a veritable temple of surprises to the exploring knife, there is no excuse for leaving a single stone unturned in the search for evidence which will prevent unnecessary surgical maneuvers or which will tend, even in small degree, to mitigate the suffering, shorten the convalescence, and eliminate the economic waste incident to operative manipulations on human beings. Only in those cases in which the operating surgeon is willing to recognize the diagnostic and prognostic superiority of another is he justified in delegating the preoperative care of his patients to such a one; and by the same token that surgeon who assumes the entire responsibility for the preoperative care of his cases, especially those which present features usually considered as falling properly within other fields than his own, either convicts himself thereby of delinquency toward his patient or places himself in the position of assuming to consider his own judgment superior to any other available at the time.

As to the postoperative period identically the same reasoning must be considered to apply. During any actual operative procedure it may be said parenthetically, there is relatively little danger that the best interests of the patient will fail to be safeguarded, since, characteristically, the surgeon, as well as his assistants, are keenly intent upon the task in hand, possessed of the knowledge that their own personal prowess is dependent upon bringing the patient safely through his immediate ordeal. The situation tends to be somewhat reversed, however, when the focus of attention has shifted to other matters and the patient has been turned adrift more or less on his own resources to weather the storm of recovery.

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Too frequently there is a temptation for the surgeon to shift the onus of responsibility during this period to other shoulders than his own; even a surgeon who jealously guards his reputation as an operator and who counts no sacrifice too great in the attainment of technical excellence sometimes hesitates to give equally freely of his time and energy to the complete rehabilitation of his surgical charge. Surgical success consists, in its highest interpretation, not in the number of human bodies placed under the knife or in the brillancy and cleverness with which extensive abnormal processes may occasionally be corrected, but in the general restitution of unfortunate individuals to positions of usefulness in the social economy.

III. The Importance of Cooperation between the Surgeon and His Associates Outside the Operating Room

Perhaps it may seem trite to observe that proper preoperative and postoperative care can be given patients only when there is the heartiest cooperation between the surgeon and all of his associates. It is, of course, only proper in a profession such as surgery that the expert should be accorded a full measure of respect, but the maintenance of personal dignity and a bearing calculated to command respect is not at all inconsistent with that attitude of kindness and consideration for others which inspires the cooperative spirit in the subordinate. The attitude of false superiority which one can so readily assume and which prompts one to issue now an order for this and now one for that, without taking those responsible for the carrying out of those orders into one's confidence either with respect to the indications for the treatment prescribed or with respect to the result desired, calls for nothing but condemnation. One who assumes this attitude is culpably careless, dubious as to his own abilities and understanding of the case he is attempting to treat, or devoid of proper consideration for others.

Cultivation of the cooperative spirit should begin early in the surgeon's career. Almost invariably the tendency for the neophyte placed for the first time in a position of responsibility is to attempt to obscure his ignorance and inability to cope with the situation in hand by reticence and the assumption of a dictatorial manner. On the one hand such an attitude works a very real hardship on one's associates, and on the other hand it is apt to jeopardize one's own position, for subordinates often have a specialized knowledge superior to one's own, which the wise surgeon can turn to his own advantage. First, as a hospital interne, the surgical neophyte should begin to realize that there are many matters, at least many matters of a routine and mechanical nature, which the attending nurse is by training far more competent to perform properly than he. Accordingly, without debasing himself either in his own esteem or in hers he should go out of his way to make the utmost use of her assistance; he should observe her technique especially in the simple matters connected with the intimate care of the patient, the placing of pillows, the manipulations incident to the changing of a patient's position in bed, the placing of hot water bottles and ice caps, the making and straightening of the bed, ventilation, and the like. The nurse on her part, observing this interest and at the same time recognizing the more complete and more prolonged training of her medical superior, will come to feel less and less hesitancy in communicating to him her observations concerning the patient, and furthermore will stimulate him to more exact and scientific observations on his own part by her questions and interest. As time goes on, and the simpler clinical matters are mastered, the successful interne will progress to a position in which he is placed over other internes or will be given an appointment in which he comes more or less to supervise the movements of other less mature members of his profession. Continuing the same process of consulting with, and making use of, the resources of those associated with him, his interest and knowledge will broaden

accordingly. Undoubtedly more time and energy are expended in this way than would be expended by assuming an attitude of superiority and aloofness, but the added effort will bring its own rewards both in the attention which his patients receive from attendants, nurses, and internes but also in the added esteem in which he himself is held by his associates and subordinates. He will eventually come to be regarded not only as a good clinician, but as a good executive; with this his practice will enlarge, and financial dividends will also begin to be realized.

Such a surgeon, for a surgeon he has become in the meantime, will freely express his impressions as to diagnosis and treatment as he moves about with his staff; sometimes these judgments will require revision subsequently, diagnoses will be changed, the form of therapy will be revised, but if these duties be performed openly and without dissimulation the respect of a surgeon's subordinates is never jeopardized, and not very infrequently the most valuable observations and suggestions will be forthcoming, under these circumstances, from very unlikely sources.

The good surgeon is invariably a good teacher; the lessons he has learned in the school of experience he passes on whenever he can to those of less experience, and in so doing helps those about him, but helps them in no such degree as he helps himself, for there is no way of learning which in any respect compares in efficiency with the attempt to impart knowledge to others.

IV. THE IMPORTANCE OF PRINCIPLES IN PREOPERATIVE AND POSTOPERATIVE THERAPY

Even with the closest kind of cooperation amongst all concerned in the adequate preparation of a patient for operation and with adequate care in the safeguarding of his convalescence thereafter, the rationale of preoperative and postoperative care is neither easy to grasp on the part of the neophyte nor to outline on the part of the master. This is

partly, at least, on account of the very simplicity of the measures of established value that can be employed to the ends desired and the complication of cases to be treated thereby. Nothing could be further from the truth than that one to be adept in the care of surgical patients must be master of many complicated techniques and possessor of a large medicinal and instrumental armamentarium. Just as in the case of the internist, although the pharmaeopeia contains many drugs and preparations of drugs, only relatively few of which are of any considerable breadth of application, and with the aid of these few the whole gamut of diseases must be treated as far as medicines go, just so, in the case of the surgeon, only relatively few of a large number of (especially postoperative) methods which have been tried have established themselves as applicable to any considerable number of cases and as being of sufficient value to endure. The hypodermic syringe, the stomach tube, the blood pressure apparatus, and the stethoscope constitute the bulk of the armamentarium of the surgeon outside the operating room, especially if the variations of these be included, such as the infusion, transfusion, rectal drip, enema, douche, and duodenal drip apparatuses. About the only especial mechanical skill needed in the average case is the ability to introduce a needle or cannula into a vein, and this can be acquired in a relatively short period of time. Even fewer drugs are found useful in surgery than in medicine.

Accordingly, the aim of the attendant on surgical cases outside the operating room should not be to acquire familiarity with a large number of special remedies or to elaborate cumbersome techniques, or even to keep his ear too close to the ground for the approach of some new surgical panacea, but rather should he aim to master indications for the measures which have been repeatedly assayed and not found wanting. Ultimately the practice of medicine resolves itself into a process of reestablishing normal processes which have become perverted through disease and, apart from a thorough under-

standing of the normal processes and the manner in which perversion of these processes occurs, the treatment of abnormalities becomes a hit or miss affair. If the therapeutic fads and fancies which so often make insistent claims on the attention of the medical man be heeded and allowed to usurp the place of sound reasoning and careful observation, disaster can hardly be averted. Not infrequently the very complexity of a piece of apparatus or a system of therapy is enough to condemn it and this for two reasons: (1) the complexity of the apparatus or system becomes a matter of pride rather than its efficacy, and (2) human nature being as it is, the simpler a performance can be made the more likely it is to be invoked when needed.

Nature is most kind in healing diseases, as she is most cruel in sending them; consequently the medical attendant should beware of becoming so overzealous in his attempt to combat morbid processes that he becomes actually meddlesome. Any insult to natural processes is likely to be resented by the human organism in no uncertain terms, and it behooves one to consider well one's therapeutic position before attempting to invoke measures concerning the rationale of which one is in doubt for the relief of conditions which one imperfectly understands. The conscientious medical attendant continually finds himself in a dilemma between the two horns of which he is constantly torn; shall he let well enough alone in the belief that the sum-total of the forces working for recovery are in the ascendency or shall he interfere in the belief that the day is with the forces working for dissolution? Unfortunately there is no divining rod by which the decision may be made; in the case of preoperative and postoperative treatment, as in every other branch of the practice of medicine, knowledge comes with experience and is bought only at the price of assiduity of application over a long period of time.

In surgical practice, as well as in the practice of medicine in general there can be no rational therapy without rational diagnosis. The laboratory is the surgeon's sheet-anchor in the

time of storm; accurate and reliable blood counts, serological tests, blood-chemistry examinations, urinalyses, and bacteriological examinations elucidate many an obscure complication in surgery when interpreted by a well stocked mind and keenly analytical intellect. The surgical case presents almost as many diagnostic problems as the case in the medical ward during the course of his stay in the hospital; many cases present almost daily problems for solution.

It should be axiomatic that in the absence of definite indications for therapy no therapy should be attempted. The principle involved in the use of routine or "standing" orders and stereotyped schedules which go by the clock is fundamentally unsound in medicine, and although a moderate degree of failure to individualize cases may not be actually detrimental to the interests of the surgical patient, the march of events in a surgical ward is characteristically much faster than elsewhere in a hospital, and usually when active treatment is needed it is not only needed at once but the treatment required is not that prescribed by any set form.

CHAPTER I

GENERAL PRINCIPLES UNDERLYING RATIONAL
PREOPERATIVE TREATMENT

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GENERAL PRINCIPLES UNDERLYING RATIONAL PREOPERATIVE TREATMENT

I. THE AIM OF PREOPERATIVE CARE

The general aim or object of the preoperative care of surgical patients is threefold:

(1) the establishment of a full and complete preoperative diagnosis;

(2) the minimizing of the risk incident to the contemplated operative procedure as such, especially by attention to the stabilization of metabolism, selection of the optimum time for operation, and the correction of such associated morbid conditions as are amenable to medical or minor surgical therapy;

(4) the prophylactic treatment of postoperative complications.

II. EMERGENCY OPERATIONS AND DELIBERATE OPERATIONS

In those cases in which the time factor is of no particular moment or in which the general condition of the patient is favorable and the need for operative interference is not pressing, the accomplishment of the threefold object of preoperative care may be virtually complete. Such preparation sometimes occupies a number of months; for example, in the patient with umbilical hernia, who is characteristically over-obese, in middle life, and therefore apt to be the subject of incipient nephritis, and who usually has an associated fatty degeneration of the heart. Such a patient usually requires dietary therapy aimed at the reduction of the obesity, which latter, if severe, would militate gravely against the success of any surgical procedure designed to restore the integrity of the abdominal wall. Nephritis, if moderately advanced, may require additional dietary restrictions to prevent untoward

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urinary complications postoperatively. Myocarditis may require an especial study of the heart and the institution of additional measures aimed at the prevention of possible postoperative cardiac failure. In such a case the preoperative treatment may obviously mean the difference between success and failure and cannot by any stretch of the imagination be crowded into a period of time measured by hours, days, or even weeks.

On the other hand, in those cases in which the life of the patient depends upon expedition in the matter of operative interference, as in the case of a strangulated hernia, ruptured peptic ulcer, or ruptured ectopic pregnancy, the preoperative care may be extremely incomplete, the patient being placed upon the operating table with virtually no preoperative care at all. In such cases the patient may succumb, may recover after a stormy convalescence, or may make an uneventful recovery depending upon circumstances very largely beyond the surgeon's control.

The distinction between the two foregoing types of cases has frequently been drawn in the past. They represent respectively the "operation of election" or the "deliberate" operation and the "operation of necessity" or the "emergency" operation.

The three objects of preoperative treatment previously mentioned must not be considered as in any sense mutually exclusive or unrelated; actually they are usually correlative. This can best be illustrated by a specific example. Taking, for instance, the case of the young adult who is suffering from indigestion of several years' duration, which indigestion ensues with regularity an hour or two after meals and is relieved by the taking of sodium bicarbonate and food, and in whom physical examination, roentgenographic studies, and analyses of gastric contents indicate the presence of peptic ulcer, adequate preoperative treatment involves a number of features which considered from one point of view fall within one classification of the preoperative care, whereas considered

from another point of view they fall under another classification. The *institution of a period of medical treatment* not only may confirm the diagnosis, which confirmation is a part of the first mentioned aim of preoperative care, but it may also increase the general resistance of the patient, which, in turn, on the one hand, tends to minimize postoperative wound infection (a part of the third object of preoperative care) and on the other hand, renders him a better immediate operative risk (a part of the second object of preoperative care). The *eradication of foci of infection in the mouth by the extraction of teeth*, on the one hand, may overcome an anemia secondary to that infection and thus minimize the immediate risk of operation, which is a part of the second object of preoperative care, while at the same time eliminating a possible source of postoperative pulmonary complications, for example, pneumonia, which is a part of the third object of preoperative care.

In those cases in which there is a choice in the matter of the time of operation, frequently that surgeon is wisest who relies not altogether on his own resources in preparing his patient for the ordeal of surgery. Those cases falling within such a classification which present the most trying preoperative problems are almost invariably victims of organic diseases which, except for some incidental surgical complication, are proper subjects for the attention of the practitioner of internal medicine or one of the allied specialties. As outstanding examples of such cases may be mentioned, to catalogue but a few, patients with tuberculosis, diabetes, advanced nephritis, and advanced cardiac disease. Unless the surgeon belongs to a small gifted group of practitioners whose knowledge and experience justify the practice of truly "general medicine," patients such as these should have the benefit of the combined preoperative medical judgment of at least two consultants, the surgeon and the internist, and an attempt should be made by both practitioners in the most unselfish spirit to pool their resources.

This is usually not only a fairly easy matter, but one which, if properly handled, is capable of extending the professional influence of both types of practitioner. Surgical cases are usually referred to the practitioner of surgery by the practitioner of medicine, and the enlistment of the latter in the general care of the patient both preoperatively and postoperatively offers in many cases the possibility of a satisfactory solution of the problem of the equitable adjustment of fees, a problem which for years has been an active subject of debate whenever cases are referred to surgeons for advice and treatment.

III. THE FIRST GENERAL OBJECT OF PREOPERATIVE CARE, OR THE IMPORTANCE OF AN ADEQUATE DIAGNOSIS

With regard to the determination of a diagnosis Bailey[1] makes the following very pertinent observations:

The making of a surgical diagnosis resolves itself into seven stages— usually not more than three or four of these will be found necessary in any specific case.

1. The taking of a history, and the general observation of the patient.
2. The elicitation of physical signs.
3. A mental process on the part of the surgeon whereby 1 and 2 are sifted and correlated, and a logical conclusion is drawn.
4. A differential diagnosis is entertained: this is also a mental process— largely one of exclusion, but reinforced when possible by further physical signs.
5. A scientific confirmatory test—usually performed by a colleague— e.g., x-ray, chemical, bacteriological, and histological examinations.
6. The more accessible parts of the interior are rendered visible by ingeniously constructed tubes, such as the cystoscope, sigmoidoscope, esophagoscope.
7. An exploratory operation is performed.

If a diagnosis is still found wanting after the seven stages and combinations thereof have been exploited, there remains but one last court of appeal, the post-mortem room.

The seven stages may be termed the "surgical crescendo."

Of these seven stages the first three are by far the most important; so important in fact, that to a very large extent they determine all the others, for if the history and the physical

signs have been inadequately or incorrectly elicited or if illogical conclusions have been drawn from even properly elicited history and physical signs, there is likelihood that confirmatory tests, special examinations, and the like will not be employed, or if employed will not be able to correct original faulty impressions.

Since the fundamental concern of this treatise is not with diagnosis but rather with treatment, the matter of history taking, physical examination, and special examinations can receive no more than passing mention. Such consideration as is paid to these matters in the brief paragraphs which follow is offered merely for purposes of emphasizing the fundamental importance of completeness, common sense, and honest effort in surgical diagnosis.

A. HISTORY TAKING: The taking of a good history is an art, the fundamentals of which may, nay must, be learned from some good textbook on the subject, but the mastery of which comes only from assiduous application to the art in a long series of cases and over a period of time measured, not in months, but in years, and best under the strict tutelage of a mentor.

The surgical master elicits a history apparently without effort and as a matter of instinct; the neophyte does the same laboriously, after many fruitless meanderings, and incompletely. Like the mastery of one's native tongue, history taking is learned not by speaking, but by writing. In con-tradistinction to spoken language written language must be precise, orderly, reasonably complete, and legible, in order to be intelligible; consequently, the practice of writing his-tories tends to discourage ambiguity both in thinking and in expression, tends to force one into habits of mental orderliness and a reasonable degree of thoroughness, and ultimately facilitates rapid and accurate thinking in the absence of actual writing.

The first histories of a beginner should be painstakingly complete, and should follow a system, the particular system

being of much less importance than the completeness of the same. Final history taking at the bedside should be discouraged, at least for a considerable time during the formative period of the surgeon's career, in favor of roughly drafted notes which may subsequently be rearranged in the form of a finished history; such a practice discourages the mere following of a set form and tends to enforce a certain amount of active cerebration on the part of the medical historian. The aim of the latter should be gradually to become so expert in recording an anamnesis that irrelevant and negative aspects of the history may be omitted without jeopardizing the completeness of the report, the history detailing the building stones out of which the diagnostic edifice is constructed rather than recounting the mass of by-products and waste material which must be discarded during the process of its construction. Good histories need not be lengthy, but they must be complete and must be in such form that they convey all the essential details of the case to the reader's mind without subjecting him, whoever he may be so long as he has a modicum of medical knowledge, to very serious mental exertion in assimilating the same.

B. THE PHYSICAL EXAMINATION: There is probably no way, save one, in which a person who is entrusted with the care of surgical cases may become apprised of the necessity of careful and complete physical examinations, and this is by experience. One who has removed an appendix to relieve the "referred" abdominal pain of a basal pneumonia of the right lung and who has been subsequently subjected either to the amusement of his confreres or the self-examination consequent upon a fatality will not willingly fall into the same snare on a subsequent occasion. Neither will the surgeon who, some months after officiating at a gynecological operation, sees his patient for an inoperable carcinoma of the breast speedily forgive himself if he cannot find among his records a note to the effect that on the former occasion the

breasts of the particular patient concerned were duly examined and found normal.

1. *The Routine Blood and Urine Examinations:* Blood and urine examinations are made with the express object of shedding light upon the diagnosis of a case or upon the operative risk involved, not for purposes of adornment of the history sheet. The importance of laboratory work has frequently been so forcefully impressed upon the mind of the medical man of the present generation that he has a definite mental tendency, somehow, to esteem this form of activity as an end in itself, and to feel that as long as the "laboratory work" has been done on a patient, that patient has at least received some benefit. This attitude is, of course, absurd; unless laboratory reports can be interpreted intelligently and are, in fact, so interpreted, the patient or hospital, as the case may be, might better be saved the considerable expense and often the inconvenience, as well, which is incident to the performance of such tests.

2. *Special Examinations:* X-ray, basal metabolism, cystoscopic, and other special examinations must be made on patients as indications for the use of these various techniques arise. It would be futile to disparage these methods, which in the hands of competent persons, are of the utmost value, and such is far from the intention of those who sound a note of warning in connection with these advanced methods of diagnosis and treatment. There is a very general feeling among the better informed practitioners of surgery, however, that special examinations can be much overdone and that between special examinations poorly and inadequately performed and good surgical judgment used in the absence of such special examinations there can be no choice but the latter.

c. THE MEANING OF "COMPLETE DIAGNOSIS": When the history of a surgical case has been carefully taken and the results of a thorough physical examination have been duly noted, the surgeon is, for the first time, in a position to make a satisfactory diagnosis. Such a diagnosis will include not

only the disease or disease syndrome from which the patient is primarily suffering, but will comprehend associated and apparently unrelated abnormalities.

If the case is one of intra-abdominal disease, such a diagnosis as "acute appendicitis," "tuberculous pertonitis," "peptic ulcer," "gastric carcinoma," or "acute cholecystitis" is by no means adequate, since in the last analysis, not these lesions, but the condition of organs quite outside the abdomen may determine the actual outcome of any attempt at operative interference. If the lungs are the seat of extensive tuberculosis, the circulatory system weakened by advanced myocarditis, or the function of the kidneys decreased by progressive nephritis, even a technically perfect intra-abdominal operation may result fatally. The same applies not only to organic disease of the pulmonary or cardiorenal systems but to disturbances of metabolism, such as diabetes and disturbances of the acid-base balance. Complicating thyroid disease, persistent thymus gland, icterus, adrenal insufficiency, severe anemia, hemophilia, and a host of other abnormal conditions may also lead eventually to a fatality.

In addition to the factors which make for mortality there are many others which make for morbidity, such as, carious teeth, diseased tonsils, adnexal disease in the female and prostatic disease in the male, cystitis, pyelitis, furunculosis, otitis media, chronic malaria, and a considerable number of others.

D. The Relationship of Diagnosis to Treatment: No attempt will be made here to consider exhaustively the relationship of associated disease to surgery; the subject is far too broad and involves too many digressions into the field of internal medicine and the surgical specialties. A very brief consideration of certain complicating organic and functional diseases will be attempted in the following pages, but the primary recognition of such pathology is far more likely to be missed than the treatment and for this reason is infinitely more important. The actual treatment of disease is constantly

in a state of flux, and no man can hope to assimilate all of its ramifications, but really noteworthy therapeutic advances in this day and age receive so prompt and far-reaching publicity that the surgeon who is even a moderately assiduous student of medical literature is in little danger of overlooking them. For this reason the surgeon who is capable of recognizing or diagnosing disease is almost invariably in a position to treat it intelligently or at least to place himself in a position to treat it intelligently. Thus does diagnosis become the key which unlocks the door of treatment.

IV. The Second General Object of Preoperative Care, or Minimizing Operative Risks

A discussion of the problem of operative risks and the methods available for minimizing them can be only arbitrarily separated from the problem of the prophylaxis of postoperative complications, for it is decidedly the rule for patients to survive the actual ordeal of surgery and, in fatal cases, to succumb only after some hours or even days, and then as a result of possibly several contributing conditions not all of which may have been present in the preoperative period. Logically, however, there is a difference between the situation in which the patient actually forfeits his chances of existence on the operating table and is removed thence already doomed, and the patient whose resistance is ample to tide him over the effects of the operative seance as such, but who is unable to weather the storm of the more or less accidental hazards of the early period of convalescence.

The patient who succumbs directly as the result of an operative procedure characteristically belongs to one of four groups: (1) he is the victim of some more or less adventitious abnormality, like status lymphaticus or hemophilia, (2) he is the victim of advanced organic disease, most frequently cardio-renal, (3) he is afflicted with one of a variety of disease syndromes which are more or less easily recognized and are universally known to offer serious operative hazards, such as,

hyperthyroidism, prostatic hypertrophy, intestinal obstruc-
tion, craniocerebral injuries, and certain varieties of biliary
disease, or (4) the malady which brings him to the operating
table is a calamity such that immediate surgery is imperative
while at the same time offering little hope of permanent avail.

A. THE HAZARD OF ADVENTITIOUS ABNORMALITIES: Al-
though the adventitious abnormalities which are capable of
causing sudden dissolution during the course of an operative
procedure are incompletely known, a most painstaking exam-
ination of a patient preoperatively will rarely fail to disclose
phenomena suggestive of an impending catastrophe.

The patient afflicted with "emotional imbalance" is
frequently a particularly poor operative risk. It may be that
in the future much more will be learned concerning this condi-
tion, which for the present represents little more than a name,
and it is not unlikely that some efficient method of preopera-
tive treatment will eventually be elaborated for its control.
Perhaps such control will be made possible by better under-
standing of the interaction of the glands of internal secretion.
For the present the principle of Crile's "anociation" probably
offers most with respect to treatment in such cases, and will
bear much closer study than is frequently accorded the sub-
ject. The use of morphine preoperatively is particularly
indicated in such conditions, and this,drug may frequently be
combined advantageously with scopolamine.

Unduly apprehensive patients usually withstand the effects
of operation poorly, and it is not altogether superstition which
occasionally prompts the surgeon to delay operative inter-
vention in such cases in the hope that a patient's attitude of
pessimism may abate somewhat before the actual surgical
ordeal is begun. Unconsciously, perhaps, every successful
surgeon uses psychotherapy to some extent, and if a surgical
attendant be possessed of any particular gift in this direction
he will find few occasions on which to use it to better advantage
than in the case of the preoperative patient who is partly or
completely convinced that his chances of survival are small.

There should be no excuse nowadays for the inadvertent subjection of a hemophiliac to serious operative procedures. Not only should a carefully taken history suggest the presence of such a condition as hemophilia, but coagulation and bleeding-time reactions are available for detecting any undue tendency toward hemorrhage and should be made routinely, or, as an absolute minimum, whenever explicit questioning of the patient or his relatives discloses a suggestive history.

The possibility of "status lymphaticus" must be remembered in children. The condition is not frequently encountered, but when it is present, even minor operations may eventuate in a very dramatic climax. Greenthal[2] is authority for the statement that 50 per cent of cases occur in children who are victims of congenital defects and deformities. The most reliable direct way of recognizing the condition is by means of the skiagraphic study of the patient and the detection of an area of density in the region of the thymus gland not otherwise explainable. The treatment for such a condition is x-ray therapy until the thymic shadow has been reduced to its normal size.

B. The Hazard of Advanced Organic Diseases: Certainly with all the facilities at the command of the modern surgeon no case of advanced organic disease should be allowed to come to the operating table unrecognized. Frequently it is necessary to operate on such persons in spite of an unfavorable general condition and occasionally in emergencies to operate upon them even in the absence of any very formal attempt at ameliorating their condition; but to fail through ignorance to give such patients the benefits of any possible aid would be quite inexcusable.

1. *Chronic Cardiac Disease:* Persons past middle age should always be suspected of being sufferers from cardiorenal disease unless proved otherwise, and when cardiorenal disease is found, a painstaking attempt should be made to evaluate the extent of the disease as well as to ameliorate the patient's condition as much as possible by suitable therapy.

FIG. 1.

FIGS. 1–2. Roentgenograms of two patients with persistent thymic shadows. Note the triangular or keystone-shaped shadows indicated by the arrows. When patients are treated with suitable deep x-ray therapy, the shadow progressively decreases in size until it disappears. Note that the shadow is quite distinct from that cast by the heart and arch of the aorta. (Roentgenograms from Touro Infirmary, New Orleans, La., by courtesy of Dr. Walter F. Henderson.)

Fig. 2.

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As far as cardiorenal·disease itself is concerned, one's suspicions should be aroused as to its presence by the blood pressure, by the physical examination of the circulatory system, and by the urinalysis, none of which should ever be omitted in recording the physical findings of any operative case.

When cardiac lesions are suspected additional light can frequently be thrown on the case by the use of the electrocardiograph, or even the polygraph.

Hamilton[3] is authority for the statement that, with the exception of emergency surgery and excluding thyrotoxic patients, about 7.5 per cent of all surgical cases in which a careful history has been taken and an adequate physical examination has been performed will present some symptom or sign suggestive of cardiac disease.

a. Cardiac Neurosis: In a certain rather considerable percentage of patients presenting a history suggestive of cardiac disease, a careful examination of the circulatory system will disclose no signs of serious cardiac damage, and although certain of the individuals belonging to this group are greatly disabled by their symptoms and feel unable to undertake the usual activities of persons in similar circumstances of life, yet under the actual strain of surgical procedures they present no greater operative risk than do normal individuals; they do not develop true heart failure under the stress of surgical procedures. Such patients are commonly classified as victims of "cardiac neurosis" or "neurocirculatory asthenia."

Amongst the symptoms presented by these patients may be mentioned (1) *cardiac pain*, which is especially common and which is usually precordial, but may rarely be substernal or referred to the neck or arm; it bears no constant relationship to exertion; (2) *breathlessness*, which may or may not be associated with exertion or excitement, but which is characteristically associated with some phobia, such as the sensation of breathlessness or smothering when in crowded or closed places; (3) *rapid heart beat*, which may be persistent or may become noticeable only as a result of excitement or exertion, but which

does not present the phenomena of sharp onset and remission, and which is associated with "palpitation," i.e., unpleasant consciousness of the heart beat; and (4) *easily induced fatigue,* which may manifest itself merely as a feeling of weakness or giddiness or occasionally in true syncope.

Inasmuch as such patients present no especial surgical risk, they require no especial preoperative treatment. The only danger in connection with this group of cases is the danger of misdiagnosis, and if a reliable consulting internist be available, patients with essential cardiac disease will not be likely to be wrongly classed with such a group of cases.

b. Extrasystoles: A second group of cases, much smaller than the aforementioned one, consists of individuals who are troubled by the cardiac irregularity known as "extrasystoles." This irregularity may develop only under the strain of exercise, and may occur either frequently or only at long intervals. Such cases as exhibit extrasystoles, provided the true nature of the condition can be determined by electrocardiographic studies, or otherwise, need occasion no particular anxiety, since they withstand the strain of surgical procedures well. Even aggravated cases of true extrasystoles require no special precautions, and never present indications for active stimulation. This particular cardiac irregularity is apt to give the anesthetist and others who watch the patient during the period of anesthesia and of convalescence more cause for anxiety than the condition really warrants.

c. The Potential Cardiac: A third and larger group of cases belongs within a classification which is hard to define. They are the possible or "potential cardiacs." In this group are included patients with varying degrees of systolic murmur and of murmurs of different qualities, and variable location, persistence, pitch, and transmission, and patients with "third" heart sounds. Occasionally some of these patients have slight or doubtful cardiac enlargement. In the event that no more tangible evidence of organic heart disease is found, this class of patients can be regarded as very favorable surgical risks, as far

as their cardiac condition is concerned. Decompensation does not occur as a result of operative procedures, and the patients weather the storm of convalescence without mishap, quite in the absence of all supportive measures.

d. Significant Heart Disease: About 2 per cent of the patients in a general surgical clinic (excluding patients with thyroid disorders) belong, according to Hamilton,[3] to a fourth group, the true cardiacs, or the patients with "significant heart disease."

Among the more important clinical manifestations presented by this group are (1) definite cardiac enlargement, (2) significant disorders of the heart beat, and (3) signs of present decompensation or a history of previous decompensation, i.e., "heart-failure."

All patients belonging within this group must be regarded as presenting a more or less definitely increased surgical risk over patients with normal hearts.

Recognition of cardiac enlargement is largely a matter of careful physical examination by the ordinary methods of palpation and percussion, but in doubtful cases the roentgenogram is of value either in the form of a "6 foot" plate or teleoroentgenography. The electrocardiographic tracing will elucidate the character of most of the significant disorders of the heart-beat, but it commonly fails to demonstrate one of the most important irregularities, viz., "pulsus alternans." The latter phenomenon is customarily appreciated only by noting, during the course of blood-pressure determinations, that alternate arterial pulsations are obstructed at a relatively low pressure, whereas the intermediate pulse beats are lost only at a relatively much higher pressure. The electrocardiogram signally fails to determine, or even to suggest, the source of many cardiac conditions, such as simple tachycardia. The factor of decompensation is of far greater surgical significance than either enlargement of the heart or disorder of the heart-beat, and fortunately for the clinician whose equipment is modest, decompensation is, as a rule, sufficiently easily recog-

nized by the unaided senses. There are, however, no simple, infallible tests by which the cardiac reserve of a patient can be accurately determined, and therefore, it is impossible to determine with accuracy when decompensation is imminent.

Sir James Mackenzie and Orr[4] define heart failure as "that condition in which the heart is unable to maintain an efficient circulation during efforts necessary for the daily life of the individual." So far as the propulsion of blood is concerned the circulation depends upon the integrity of the cardiac musculature, and failure of this musculature to maintain or provide sufficient propulsive force constitutes heart-failure.

Heart-failure occurs in two general types, (1) the "congestive," and (2) the "anginal."

Congestive decompensation results whenever the heart becomes unable to propel blood into the large arteries as fast as it accumulates in the large veins. Venous stasis ensues uponsuch failure, and the organs bearing the brunt of the stasis are the liver and the lungs. The liver becomes engorged with blood, tender, and possibly even painful; ascites, or even general edema may ensue. Engorgement of the pulmonary veins may produce breathlessness, râles, cough, and hemoptysis. Congestive failure may, of course, be acute or chronic, mild or severe, fleeting or persistent.

Incidentally, there is a danger, not entirely fanciful, of misinterpreting upper abdominal pain or tenderness due to passive congestion as a surgical condition within the abdomen. Operations on patients suffering from such pain are by no means unknown.

Anginal decompensation occurs characteristically only in patients of middle life or those of advancing age. In this type of failure there is underlying disease of the coronary arteries; disease of the coronary arteries by interfering with the intrinsic circulation of the cardiac musculature interferes with the circulation at its source.

The symptoms of anginal heart-failure are entirely subjective at first; the subjective phenomena range all the way

from insignificant discomfort to the agony which can truly be called excruciating (ex cruce, crucifixial) and involve a fairly wide, though well defined, anatomical area, notably the precordium, the retrosternum, and the epigastrium. The pain or discomfort may, or may not, radiate; when it does, it extends almost exclusively to the left side, shoulder and axilla, arm, wrist, little finger, and neck, the gums, tongue and jaw, or the scapula.

Physical or mental exertion may precipitate an attack, as may exposure to cold and sleeplessness; the attack may be accompanied by salivation and sweating, and may be followed by profuse urination.

In evaluating the cardiac significance of subjective symptoms, such as those just previously mentioned, the neurological reaction of the patient must be considered, since fairly well defined symptoms in a hypersensitive individual may mean little objectively, whereas the reverse holds equally true. Pressure on the skull behind the ear has been suggested as a means of determining hypersensitivity, this area being relatively insensitive in the normal individual. It should also be noted that symptoms of a given severity do not usually represent equal degrees of cardiac impairment in both males and females; symptoms are to be interpreted somewhat more seriously in the case of males than in the case of females.

The signs of coronary disease are of less significance and reliability; they consist of (1) reduplication of the first apical sound, (2) muffling of the heart sounds at the apex, in the absence of emphysema, and (3) extrasystoles, which are increased by exercise.

Phelps states[5] that all patients presenting the first of these signs, regardless of the symptoms presented, have died within two weeks of any major surgical procedure attempted. He believes that an operation involving as much shock as a cholecystectomy will prove fatal in a male with even mild coronary disease unless means are taken to support the heart, though this may not be true of the female on account of the sex difference noted above.

The patient with coronary disease is, of course, a distinctly unfavorable surgical risk. There is, incidentally, a very real danger of misinterpreting the sudden severe pain of an anginal attack for some surgical catastrophe like acute pancreatitis or ruptured peptic ulcer.

The successful preoperative preparation of the patient with true chronic cardiac disease depends far more upon a prolonged period of rest in bed and the selection of a favorable moment for operation, than upon any specific artificial measures which may be used for the amelioration of the cardiac condition as such. During the preoperative period careful nursing, protection of the patient from sources of mental perturbation, and strict observance of the general principles of hygiene are essential. When contemplating an operation of election on such patients the surgeon should be an opportunist and seize upon a favorable moment for interference; the patient's apparent general condition should be the guiding factor rather than any arbitrary standard of time or convenience.

The value of digitalis in the preoperative preparation of patients with cardiac disease is a somewhat mooted question. There is rather general agreement that this drug is of definite value both preoperatively and postoperatively in the treatment of auricular fibrillation. It invariably slows the cardiac rate appreciably and spares the heart many useless and wasteful impulses.

With regard to the use of this drug in the preoperative treatment of other types of cardiac disturbance there seems to be no consensus of opinion among authorities; some are liberal in their interpretation of the indications for its use, others are inclined to be conservative. In any case, if digitalis is to be used at all it should be used in full therapeutic doses, and such dosage is now fairly definitely established.

The average is as follows: 1.5 gm. of a standardized powdered leaf or its equivalent is required to maintain a maximal effect previously secured, and 1.5 grains for every 10 lb. of body weight during a period of twenty-four hours is required to produce the initial effect.

retion is so frequently a decisive factor in the ultimate
cess or failure of major surgery that specific attention
uld invariably be paid to it. Fortunately the modern surgeon
n a far better position to detect disturbances of renal func-
n than his forbears, and no surgeon can now be considered
have done his full preoperative duty by a patient if he has
eliminated the possibility of serious renal abnormality on
one hand, or, on the other hand, finding renal impairment
sent, has not instituted suitable treatment in accordance
h the indications furnished by quantitative chemical tests.
ordinary cases of urinary dysfunctions two or more of the
owing tests should be applied and correlated:

a. The Phenolsulphonephthalein Test: This test was
vised by Rowntree and Geraghty and depends upon a cal-
ation of the rate of excretion of a foreign substance by the
neys. Inherent in the rationale of the test is the assumption
it the normal kidney always excretes the paticular substance
enolsulphonephthalein) at or above a given normal rate,
ereas in disease the degree to which the excretion rate is
ninished for the foreign substance accurately represents the
gree to which the excretion rate is diminished for the normal
retory products of diuresis.

The ability of the kidney to excrete phenolsulphonephthal-
does not actually correspond with its ability to excrete the
rmal substances eliminated by diuresis. Apparently about
per cent of the eliminative power of the kidney must be
t before diminution of phenolsulphonephthalein excretion
n be detected, and for this reason positive findings have
ore value than negative ones in the use of this particular
t. The test is, however, sensitive enough to detect degrees of
al impairment not accompanied by urea retention, and it is
o applicable to the estimation of the function of each kidney
arately.

In the actual performance of the test several considerations
ould receive especial attention:

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(1) Twenty minutes or so before receiving phenolsulphonephthalein the patient should be given a sufficient amount of water by mouth (200 to 400 c.c.) to favor active diuresis.

(2) The bladder should be completely empty at the time the dye is injected, or at least should be emptied immediately thereafter.

(3) Exactly 6 mg. of the dye should be injected so that when ampoules of solution are used, an accurate syringe should be used and care should be taken to measure and inject exactly 1 c.c. of the solution, which is of a strength of 6 per cent.

(4) Real accuracy in performing the test cannot be expected in the absence of catheterization of urinary bladder or ureters, as the case may be.

(5) "Appearance time" and rate of excretion vary normally with the method of injection. When injected *intravenously* the following norms are accepted:

(a) Appearance time, four to six minutes.

(b) Amount normally excreted in fifteen minutes, 35 to 40 per cent.

(c) Amount normally excreted in thirty minutes, 50 to 65 per cent.

(d) Amount normally excreted in sixty minutes, 65 to 80 per cent.

When injected intramuscularly the rate of excretion is somewhat less.

(a) Appearance time, ten minutes.

(b) Amount normally excreted in thirty minutes, 30 to 40 per cent.

(c) Amount normally excreted in sixty minutes, 40 to 60 per cent.

(d) Amount normally excreted in two hours, 80 per cent.

b. The Urea Concentration Test: The urea concentration test consists of the following steps:

(1) The patient empties the bladder completely, or it is emptied for him by catheter.

(2) He then drinks a solution of 15 gm. of urea in 100 c.c. of water; this solution may be flavored with *tictura aurantii* if desired.

(3) At the end of one hour and again at the end of two hours the contents of the bladder are evacuated and collected; the amount of urine excreted during each of the two one-hour periods is measured, and the percentage of urea in the second specimen is determined.

If more than 300 c.c. of urine is excreted during the two-hour period an abnormal diuretic effect is attributed to the urea, and the urea concentration value for the second specimen must be interpreted accordingly. A urea value of less than 2 per cent in the second specimen is ordinarily considered as indicating renal impairment and the degree of impairment is considered as directly proportional to the degree of departure from the normal value.

c. Mosenthal's Test: Originally the Mosenthal test involved the use of a special diet, the so-called "high protein diet," but since the essential facts elicited when using such a diet may be about equally well determined in connection with any normal diet, the technique has been subsequently simplified.

The test as commonly performed proceeds as follows:

(1) At 8 A.M. the patient completely empties his bladder and then eats his customary breakfast.

(2) At 1 P.M., or thereabouts, he eats his customary lunch, and about 7 P.M. his usual dinner, but he is allowed neither food nor drink at any time between meals.

(3) Separate collections of urine are made at 10 A.M., 12 noon, and 2, 4, 7, and 10 P.M., and these are properly labeled and set aside for subsequent examination.

(4) At 8 A.M. on the following morning the bladder is again emptied and the contents, together with any urine which may have been passed during the night, are placed in a container labeled "night urine."

(5) The volume and specific gravity of all the various samples are subsequently determined, and the twenty-four hour excretion of sodium chloride and nitrogen is calculated.

The following norms are recognized:

(a) A specific gravity of at least 1.020 must be obtained in one or more specimens.

(b) The extreme variation of specific gravity between specimens must amount to at least 0.009.

(c) The amount of "night urine" must be not greater than 760 c.c., and an amount exceeding 400 c.c. must be regarded with suspicion.

(d) An excretion of more than 5 gm. of sodium chloride in twenty-four hours indicates unnecessary ingestion of this substance.

(e) An excretion of 5 to 6 gm. of nitrogen indicates that sufficient protein is being catabolized to maintain the individual's health and strength.

A "fixation of specific gravity at a high level," i.e., a condition in which the specific gravity of all specimens is 1.020 or thereabouts should excite suspicion of the presence of acute, subacute, or chronic nephritis or passive congestion of the kidney. The possibility of inadequate fluid intake should, of course, be previously excluded.

A "fixation of specific gravity at a low level," a condition known also as "hyposthenuria," is suggestive of a variety of conditions, diabetes insipidus, chronic nephritis, severe anemia, cystitis, pyelitis, polycystic kidney, prostatic hypertrophy, and urethral stricture.

d. Blood Chemistry: The value of blood chemistry examinations in the estimation of kidney damage can scarcely be overemphasized. A sufficient number of estimations of certain of the more obvious chemical constituents of the blood have now been made to establish the normal variations of these substances accurately. When certain of these substances fail to be excreted in normal amounts by the kidney they tend to accumulate in excess in the blood stream, and under such

circumstances a quantitative chemical analysis offers information of great value, since, other things being equal, the magnitude of the excess in the blood stream of these substances over normal may be taken as a direct measure of defective renal excretory function. The substances of particular importance in estimations of kidney function are (1) the so-called "nitrogenous waste products," uric acid, urea, and creatinine, and (2) the blood chlorides.

Since the capacity of the kidney for eliminating one substance is not necessarily accompanied by impairment of its capacity for eliminating others, it is often necessary to make quantitative analysis of more than one constituent of the blood before concluding that no impairment of function exists. This is particularly true in connection with the two fundamental clinical types of chronic nephritis, (a) the "chloride retention" variety, and (b) the "nitrogenous retention" variety. An estimation of the urea content of the blood is of no value in establishing or refuting the occurrence of chloride retention, or is an estimation of the chloride content any criterion of the existence or non-existence of impaired nitrogen excretion.

There is some evidence that in cases showing nitrogen retention uric acid values are a somewhat more sensitive criterion of renal impairment than urea determinations; apparently uric acid retention somewhat precedes urea retention. Because of the relative difficulty of performing uric acid determinations, urea estimations are, however, more frequently performed. Creatinine values rise terminally, and in cases of chronic nephritis by the time clinical increases in this substance are demonstrable the condition of the patient has usually already become critical.

For a more detailed account of the diagnosis of impaired renal function and for the entire discussion of the methods used in treating the various types of impairment the reader is referred to standard texts in internal medicine.

Diabetes is a constitutional disease of sufficient surgical importance to require separate and detailed discussion; there-

fore, for a consideration of this disease the reader is referred to a subsequent chapter.

c. The Hazard of Special Surgical Disease Syndromes: Of the disease syndromes known to offer serious operative hazards much more must be said in later pages; indeed, a considerable part of any treatise on preoperative and postoperative treatment must necessarily consist of a consideration of these conditions. The plan of this presentation provides for separate chapters in discussion of the more important syndromes, and to these chapters the reader will turn in due time.

d. The Hazard of Surgical Calamities: For the last class of patients, those for whom surgery offers a desperate chance, because of the development of some sudden and over-whelming calamity, frequently little can be done by way of preoperative treatment to increase their chances for survival of the operative ordeal. However, a word of general counsel may be offered which may in certain cases prove of the greatest value. To proceed in such cases to operative interference with-out considering the possible value of such emergency measures as blood transfusion or intravenous infusion would be to court disaster unnecessarily. Frequently, moreover, a prelimi-nary period of treatment for shock may be perfectly feasible and may occasionally save the life of a patient which would otherwise be needlessly sacrificed. In general it is true that there are relatively few operative procedures, aside from the control of massive hemorrhage, in which time cannot be safely taken for a reasonable amount of deliberation in outlining treatment, and the delineation of a plan of procedure such that a subsequent review of the manipulations performed will provide no sources of regret because of oversight due to unwise haste.

v. The Third General Object of Preoperative Care, or the Prophylaxis of Postoperative Complications

Since the treatment of so many postoperative complications is essentially prophylatic, one of the most essential features in

the preoperative preparations of any patient is the observation
and investigation of the case with reference to the possible
development of postoperative complications and sequelae.
One should ask oneself very frequently during the course of the
preoperative observation of any patient what accidents may be
expected to occur to this particular patient during the course
of convalescence from his anticipated operation.

A major portion of the discussion of the preoperative treat-
ment of postoperative complications can be undertaken most
conveniently in connection with a formal discussion of the
various complications themselves, and accordingly such dis-
cussion is largely reserved for later chapters devoted to post-
operative treatment. As certain classes of patients, however,
are especially prone to develop particular complications, a
short general discussion of this phase of the subject may profit-
ably be interpolated at this point.

A. The Special Care of Infants and Children: Infants
and children present especial problems in preoperative and
postoperative care mainly because of the unstable condition of
metabolism in the early years of life.

Children are very likely to lose weight merely as a result of
changing their environment from that of the home to that of
the hospital, and, accordingly, except in urgent cases there is
an especial indication to be in no particular hurry in operating
upon a child.

The instability of metabolism in the early years of life mani-
fests itself especially in a tendency to the development of
acidosis and a condition akin to uremia, which is characterized
by stupor, convulsions, and fever. Apparently both conditions
are frequently secondary to dehydration, acidosis depending
partly upon failure to excrete acid sodium phosphate properly
from a concentrated blood and partly upon improper
metabolism of fats, and uremia, or at least a preuremic state,
depending upon retention of nitrogenous or other waste prod-
ucts in the blood stream due to improper urinary excre-
tion, again secondary to a condition of increased blood
concentration.

It must be remembered that starvation acidosis is particularly prone to occur in the early years of life; the metabolic rate is high, since the ratio between the exposed surface and the weight of the body is high, and also since growth is occurring with rapidity. Under these circumstances when food is withheld rapid inroads are made into the stored fats of the body with the consequent production of a rapidly progressive ketosis.

B. CHRONIC ALCOHOLIC SURGICAL RISKS: McMechan[6] and others have called attention to the fact that chronic alcoholics are especially subject to untoward complications. In these patients the heart, brain, liver, adrenals, and kidneys are oftentimes the seat of organic changes, and they are usually victims of continuous hypo-oxidation, which is equivalent to saying that they suffer from a persistent form of acidosis. Preoperatively such patients should be provided with large amounts of carbohydrate foods, fruit juices, and alkaline water. Postoperatively they frequently require a transfusion to combat circulatory embarrassment, and intravenous administration of dextrose to combat acidosis, spinal puncture as a means of relieving delirium tremens and alcoholic coma, and full therapeutic doses of some reliable sedative drug.

C. PREOPERATIVE CARE OF THE TUBERCULOUS PATIENT: The development of a so-called "aspiration pneumonia" is the complication most to be dreaded in operations on tuberculous patients. As will be explained in a subsequent chapter devoted to the discussion of postoperative pulmonary infections, the exact mechanism by which "aspiration pneumonia" becomes established is by no means settled, and it is very doubtful whether the mere aspiration of infected material into the pulmonary system, as suggested by the term "aspiration," accounts *per se* for the development of the complication. Whatever the theory accepted as accounting for the development of postoperative pneumonia in tuberculous patients, the presence of infected material in the upper respiratory tract is undoubtedly, at least in part, responsible, and certainly the aspiration of such material plays some very important rôle in the etiology.

Since inhalation anesthesia predisposes to such a development, the use of this form of anesthesia would probably best give way to the employment of some other method whenever possible.

The toilet of the upper respiratory tract is also of the utmost importance in preparing tuberculous patients for operations. Most such patients cough up and expectorate very freely in the morning the secretions which have accumulated during the night; unless scrupulous care is taken, therefore, on the morning of the operation, to sterilize the tract through which these secretions have recently passed an undue amount of risk is taken. Thorough mechanical cleansing of the mouth and throat and the careful use of a suitable antiseptic spray or gargle are undoubtedly of considerable prophylactic value.

In cases in which operations on the chest itself are to be performed, e.g., phrenicotomy and thoracoplasty, immobilization of the unaffected side, particularly in the region of the apex of the lungs, has been suggested as a valuable prophylactic measure. Various forms of adhesive strapping and special forms of apparatus have been devised for this purpose. The patient is also cautioned against deep breathing, and attempts are made to teach the patient to make use of the diaphragmatic type of breathing for a considerable period of time prior to operation.

Against the possible aspiration of vomited material during the course of the anesthesia the best prophylactic measure is probably gastric lavage just prior to the commencement of the anesthesia. In addition to this, the anesthetist should be constantly on the alert during the course of the anesthesia to prevent vomiting and aspiration by skill in the administration of the anesthetic and by manipulation of the patient's posture.

In the event of the development of high temperature after operation this contingency is to be combated, not by the use of depressing antipyretics, but rather by hydrotherapeutic measures, sponging of the extremities with water at a tempera-

ture of 85 to 90°F. or even lower, every two, three, or four hours, as required.

D. The Presence of a Positive Wassermann Reaction in Operative Cases: The presence of a positive Wassermann, Kahn, or other reaction used as an indication of active syphilitic infection cannot be regarded as a contraindication to operative procedures for the relief of acute conditions.

Athough certain surgeons apparently believe that operative wounds do not heal as well in syphilitic patients as in non-syphilitic patients, e.g., Gibbon,[7] Bartlett,[8] Cumston,[9] Senger,[10] Gellhorn,[11] Mondoça,[12] Darnall,[13] and Menninger,[14] there is apparently no good reason for taking the unfavorable influence of lues very seriously except in the case of fractures. Gelle[15] and most authorities on fractures seem to accept syphilis as an important cause of non-union in fractures. Certainly most authors who have written extensively on the subject of post-operative wound healing fail to make a point of the unfavorable influence of syphilis, and such influence is probably generally unrecognized by active surgeons who habitually operate upon classes of patients in whom the incidence of the disease is extremely high, e.g., in the American negro. Darnall,[13] who recognized syphilis as a cause of delayed wound healing was able to cite only 3 cases from an active service of over twenty years, and Goeckerman[16] from a detailed study of the records of 78 cases of syphilis, 28 of which were untreated, concluded that untreated cases only rarely develop postoperative complications in the wound and that treated patients present no greater surgical hazard than non-syphilitic cases. This undoubtedly has been the experience of a large number of surgeons.

Naturally, one does not deliberately operate by choice on patients with any active systemic disease, especially one which yields so readily to therapy as does lues, and it should go without saying that whenever the surgeon has a choice in the matter he should insist that adequate antisyphilitic treatment be provided his patients preoperatively, this being quite as much from the point of view of safety to himself and his

assistants as from that of benefit to the patient, for the inoculation in the surgical amphitheater of physicians and attendants with syphilis is by no means an unknown accident.

E. SELECTING THE ANESTHETIC: In all major surgery, but especially in surgery on the so-called "poor risk" case, the anesthetist and the anesthetic are increasingly being recognized as important factors. An anesthetist cannot do his best work when he is merely called upon to render the patient unconscious while somebody else operates.

The choice of an anesthetic depends upon the nature of the operative procedure proposed and the condition of the patient to be submitted to the ordeal. The whims and fancies of the operator constitute no valid grounds for choice. It seems probable that many postoperative pulmonary complications at least can be avoided by proper selection and skillful administration of anesthetics.

The tendency in this country is more and more toward doing away with the layman anesthetist and the nurse anesthetist and to delegate this most important duty to one thoroughly trained by a considerable period of study, instruction, and research in the specialty of anesthesia. It is only fair that a competent individual should be taken into the confidence of the surgeon and be provided with such information as is in the surgeon's possession for a complete understanding of the condition of the patient to be anesthetized.

The surgeon's attention is ordinarily so completely absorbed by the task in hand, once the operative procedure has begun, that he is in no position to supervise the administration of a general anesthetic, and accordingly he often finds himself more or less at the mercy of the anesthetist during a general anesthesia. Certainly no surgeon can do his best work when his attention is divided between the operative procedure itself and the supervision of the activities of the anesthetist.

Furthermore, the situation in which the surgeon becomes his own anesthetist by adopting spinal, sacral, splanchnic, paravertebral, or other varieties of analgesia is far from ideal in

major surgery since the safety of such methods depends to a very considerable extent upon the early recognition and immediate rational treatment of any complications which may arise, particularly depression in the blood pressure. The safety of the patient urgently demands that if at all possible some competent person besides the surgeon be present at the operating table to assume responsibility for the successful progress of the analgesia, whether this person be actually responsible for its induction or not.

Specific tests purporting to be of value in the direct determination of a patient's ability successfully to withstand the depression incident to the administration of a general anesthetic should be regarded with suspicion. Amongst the best known are the "Sabrasez breath-holding test" and "Moot's rule," both of which are probably of little more than academic interest.

The Sabrasez Breath-holding Test: The patient after a short rest is placed in a reclining position. At the end of a normal inspiration the nose is pinched, and the patient is instructed to keep from opening the mouth to breathe for just as long a time as possible. Twenty to thirty seconds is normal, fifteen seconds is indicative of a mild acidosis, five to ten seconds a severe acidosis.

Moot's Rule: The pulse pressure is made the numerator and the diastolic pressure the denominator of a common fraction. The range between $\frac{25}{100}$ and $\frac{75}{100}$ is considered normal, patients with values above and below these are considered poor risks.

The same rule stated in slightly different language is as follows: When the pulse pressure divided by the diastolic pressure (PP/DP) is greater than 75 per cent or less than 25 per cent the case is probably inoperable.

F. THE BLOOD SEDIMENTATION REACTION: Although the blood sedimentation reaction is primarily of only diagnostic significance, it is designed to determine the activity of inflammatory processes and therefore, if its value can be proved, may

be of the utmost importance in determining the most favorable time for operative intervention in certain cases as well as the likelihood of development of unfavorable reactions secondary to the activity of certain foci of infection.

The reaction has found particular popularity in connection with the activity of adnexal disease in the female and foci of pulmonary tuberculous infection in both sexes.

1. *Historical Note:* Attempts to correlate with various pathological processes the speed with which a patient's erythrocytes settle in an anti-coagulative column of blood are not new; Galen and much later John Hunter are both given credit for having noted a correlation between the speed of this phenomenon and the presence of disease. The publication of Fahraeus,[17] however, in 1918, of a series of observations on the connection between the sedimentation rate of the blood and pregnancy focussed the attention of many workers on the reaction, and since that time a considerable number of reports have been made on the peculiarities of the reaction as noted in many different abnormal conditions.

2. *Technique of the Test:* Several modifications of technique have been proposed of which only two will be mentioned specifically.

Fahraeus[17] performs his reaction in a glass test tube 17 cm. in length and 9 mm. in internal diameter which is marked to indicate a volume of 10 c.c.; 2 c.c. of 2 per cent sodium citrate solution are first placed in the bottom of the tube, and into this solution blood taken by venepuncture is run to the 10 c.c. mark; the tube is inverted to mix the contents thoroughly, and the height of the column of clear fluid which has formed at the end of one hour is taken as a measure of the sedimentation rate.

The normal value for men is found to be between 2 and 8 mm., and for women from 2 to 10 mm. with an average of 5 or 6 mm.; during menstruation in women the value is much higher, from 10 to 12 mm.

Friedlaender[18] has described at some length a modification of the test. It consists of drawing into a dry 1 c.c. hypodermic

syringe .2 of a cubic centimeter of 5 per cent sodium citrate solution, into which 8 c.c. of the blood to be tested are then quickly drawn. The blood and citrate are now carefully mixed to prevent coagulation, after which the mixture is injected into a specially constructed, dry 1 c.c. sedimentation tube. This tube is 5 cm. in length and upon it are marked the Roman numerals I, II, III, and IV, figures which indicate respectively 6, 12, 18, and 24 mm. The time of sedimentation is noted by observing the interval between the placing of the mixed blood in the tube and the arrival of the meniscus of the sedimenting red blood corpuscles at the observation mark, "Roman numeral IV." In health Friedlaender believes the sedimentation time is from twelve to twenty hours; in latent infection this time is reduced to less than one hour, and in active infection to less than thirty minutes.

3. *Theoretical Considerations:* Various theories have been proposed as to why the erythrocytes sediment faster in some abnormal conditions than in health and other abnormal conditions, but they are all somewhat nebulous. (1) Certain investigators think they have been able to demonstrate a variation between the serum albumin and serum globulin fractions of the blood, those conditions in which the globulin and especially the fibrinogen of the serum are increased constituting examples of increased viscosity and consequent delay in sedimentation time; (2) others believe that the fundamental factor is an increase in the blood lipoids, a consequent decrease in surface tension, and a decrease in electric charges on the erythrocyte; (3) still others attribute the phenomenon to the presence of some specific ferment in the plasma.

4. *Clinical Applications of the Test:* The sedimentation rate of erythrocytes has been proposed as a reliable index of the activity of a variety of inflammatory processes in the body. It has been suggested as an accurate measure of the activity of (1) tuberculous processes, (2) inflammatory adnexal disease in the female, (3) and other more general surgical inflammatory processes even including neoplasia.

In the field of tuberculous disease certain authors have gone on record as believing that the sedimentation time gives a very reliable indication of the activity of processes in the lungs: Morriss,[19] Gardère and Lainé;[20] some authors regard it as of even greater value than the temperature chart: Dreyfus and Hecht,[21] Delhaye,[22] von Tegtmeier;[23] and one author, Cutler[24]: finds it of even greater value than the temperature, pulse, or weight curves.

Pinner, Knowlton, and Kelly,[25] however, contend on the basis of observations on 42 patients, that the sedimentation rate of erythrocytes in tuberculosis is not constant and parallel with the extent and progressiveness of the lesions; the variation in sedimentation rate in normal persons was found to vary widely, and the sedimentation rate was not found to be correlated directly or constantly with either the fibrin or cholesterol content of the blood of tuberculous patients.

In the field of gynecology certain authors regard the sedimentation test as of equal value with the leucocyte count, Noyes and Corverse[26] and Baer and Reis,[27] and others, Rumpf,[28] Pewny,[29] and Falta,[30] regard it as of even greater value than either the leucocyte count or the temperature chart.

In the field of general surgery it has been stated that the test is of value in the diagnosis and prognosis of many surgical conditions, that it frequently proves of value in determining the proper time for the institution of surgical intervention, and that it may be relied upon as an aid in differentiating between benign and malignant newgrowths: Lohr,[31] Gragert,[32] Haller;[33] one author, Rubin,[34] believes it is a more reliable indicator of the condition of the patient than is the temperature chart.

5. *Evaluation of the Sedimentation Test:* The proper evaluation of the test is exceedingly difficult in the absence of much more complete and extensive data than are at present available. The convictions of the more ardent advocates of the method by no means reflect the general consensus of opinion of authorities with respect to its value. Indeed, many have gone

on record as considering the test of little value and have produced statistical evidence to support their contention.

Two definite conclusions seem to have been established: (1) the normal sedimentation index varies within relatively wide limits, and consequently, the boundary line between normality and abnormality cannot be very closely drawn, and (2) the sedimentation reaction is not a specific test for any particular abnormal condition and, therefore, like the leucocyte count, is presumably of value not specifically but as an aid in interpreting the general clinical picture otherwise obtained.

The greatest field of usefulness of the test, as at present understood, is, doubtless, in connection with the activity of tuberculous processes, in which connection it should be considered correlatively with the temperature curve, the pulse rate, and variations in weight. For the present, not too much reliance should be placed on it in any surgical condition except as a relatively minor link in the chain of clinical evidence.

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CHAPTER II

THE PREOPERATIVE TREATMENT OF THE
AVERAGE "GOOD RISK" SURGICAL PATIENT

CONTENTS OF CHAPTER II

Chapter II

THE PREOPERATIVE TREATMENT OF THE AVERAGE "GOOD RISK" SURGICAL PATIENT

1. The Meaning of "Good Risk" as Applied to Surgical Patients

To enter further than has already been attempted into the discussion of the preoperative treatment of cases which require prolonged preliminary courses of treatment would necessitate a virtual résumé of the principles of medical treatment, and such is obviously beyond the scope of the present discussion. The primary concern of the present treatise is, on the other hand, the case which after a reasonable amount of study on the part of the surgeon is deemed suitable to be sent to a hospital for the routine preparations incident upon a relatively immediate operative procedure, and pertains, particularly at present, to the typical case, or the case of moderate severity and one which belongs to the group usually designated as the "good risk" class. "Good risk" cases may be defined as those in which careful examination by all the means at the disposal of the surgical attendant discloses no particular reason for apprehension with regard to the probability of the development of untoward complications during the period of operation and subsequent recovery, and the "typical case" may be considered for present purposes as one of abdominal section for the correction of intra-abdominal abnormalities which in the general run of cases are not attended by a serious mortality, as, for example, simple appendectomy, hysterectomy, cholecystectomy, and the like. Naturally it is not always possible to assure oneself beforehand that any given case belongs in such a classification until after the actual preoperative period of observation under such conditions as prevail in a hospital.

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ii. The Duration of Hospitalization Prior to Operation

Under ideal conditions a patient could be admitted to a hospital and kept there for as long a period of time as might be necessary to establish his clinical status to the complete satisfaction of the medical attendant. Under actual conditions such a state of affairs rarely exists; the patient is usually of only moderate financial means and cannot afford undue delay in the interests of scientific observation as such; his finances are not usually in such a state of inflation as to justify the expense incident to the performance of various tests and maneuvers possibly of interest to the attending surgeon but of no practical value to himself.

Accordingly, one of the questions which the surgeon must ask himself as soon as he contemplates sending a patient to a hospital for preoperative treatment is, "In all probability how much time will such treatment occupy?" The patient is almost sure to request an answer to this question if it is not anticipated by the surgeon.

The answer depends partly upon the facilities which the surgeon has at his disposal for diagnosis and general treatment outside of the hospital and partly upon the particular condition of the patient. It must always be remembered, however, that no matter how carefully an operative case has been prepared outside of an institution, the moment the patient is admitted to such an institution he assumes a relationship to the latter as well as to his consulting surgeon. A hospital cannot hope to the maintain itself without accurate and reliable records of the cases to which it ministers, and one of the surgeon's duties to the institution in which he works, as well as to the patient, the profession of medicine, and society in general, is to insist that a reasonably complete and accurate résumé of the status of a case be made and carefully preserved in writing for purposes of general hospital record. This may involve repetition of some of the effort previously expended on a given case, and may include some duplication of laboratory examinations, but such is unavoidable.

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In the average "good risk" case which requires ordinary abdominal section and which stands in no acute need of operative intervention a preoperative period of hospitalization of about thirty-six hours should probably be considered a minimum. Obviously such a statement refers particularly to such cases as have been under the care of the surgeon for some time outside of the hospital, or at least have been seen by the surgeon previously and in whom a diagnosis can be made with reasonable facility and certainty. In hospitals of the charitable or semi-charitable type, which receive patients who have been subjects of little or no study previous to admission, the period of preoperative hospitalization must usually be considerably longer than thirty-six hours, and many patients who have received some previous care, but present special problems, should receive more prolonged preoperative preparation. Patients may, of course, be directed to enter a hospital at any convenient hour either of the day or night, but the later afternoon hours, 2, 3, or 4 o'clock, present certain fairly obvious features of advantage both to the patient and to the institution. As far as the patient is concerned, any last duties which may be required of him can usually best be performed while he is at the peak of efficiency, i.e., during the morning hours, and the afternoon is, therefore, the logical part of the day in which to suspend activities; furthermore, inasmuch as one of the most important indications for treatment of any sick person is rest, and inasmuch as rest is secured especially during the sleeping hours, there is a distinct advantage in vouchsafing the patient an extra night of rest in this manner. There are always a certain number of patients who rest very poorly for a night or two when placed in a strange bed in the midst of unfamiliar surroundings, and such patients commonly derive a very real advantage in being allowed at least one night in which to become accustomed to the new environment, and a second night in which to become more or less thoroughly rested in preparation for the operative ordeal. From the point of view of advantage to the institution a larger executive and nursing staff is

usually in attendance during the day than at night, and this circumstance facilitates the routine of admission and the procedures incident to the assignment of the patient to his room or ward, without at the same time imposing unduly on persons otherwise preoccupied.

The first contact with the hospital should be made as pleasant as possible for the patient, and such a state of affairs can be facilitated by the referring surgeon if he will adopt the simple expedient of preparing the hospital for the reception of the patient either by telephone or, better, by a note addressed to the proper authorities stating briefly the nature of the case and as nearly as possible the exact accommodations desired.

III. The Reception of a Patient in the Hospital

Attention to the comfort of the patient on admission to a hospital is of importance from two different points of view. In the first place, the reputation of the hospital and of its personnel depends almost entirely upon the impression which it conveys to its patients and their relatives and friends. This is perhaps a comparatively base motive but a very important one, especially in the case of the smaller institution which is not entirely or largely supported by charity. Unfortunately, the first and most impressionable years of the surgeon's life are often spent in a charity institution where, rightly or wrongly, the attitude toward the patient is mostly impersonal. The patient loses his identity as a sick person and becomes "case number so and so" or "bed number so and so." Under these conditions there is every inducement to disregard the psychology of the sick patient and to give him the impression that the institution exists for the welfare of anybody but himself. Patients convalescing from an illness spent in an institution of this type occasionally entertain any but flattering opinions of the latter and not infrequently contribute their mite to a reputation which militates against the whole-hearted support of the institution by the community. Incidentally, the surgeon

who assumes the attitude just described is apt to do more harm to himself than he does either to the institution or the patient, because such an attitude is fatal to a certain highly desirable personal esteem which, more often than not, is the keynote to success in the practice of medicine.

The other consideration is the humanitarian one which demands that the sick person, whatever his rank or station in life, be accorded every opportunity to recover his health with all possible speed.

Of course it is not always possible to receive patients immediately upon their application for admission and from that moment give them undivided attention, but the importance of habits of promptness should be impressed on all persons connected with the admission of patients, and delays in assigning them to beds and of disposing of them in accordance with such assignments are to be deplored. Orderliness and a business-like deportment, with despatch in execution of details, are much more important in this regard than any attempt at sympathy, which latter might be misconstrued and in most cases would be unappreciated, though this statement must not be considered as relieving attendants of the necessity for being thoughtful, civil, and considerate.

The sick patient is usually apprehensive and observant to a degree scarcely appreciated by any of his professional attendants. The early attendance of the surgeon to whom the case is assigned, prompt history taking and physical examination, unless such is contraindicated for some good and sufficient reason, and the early leaving of necessary instructions and orders relieves the nervous tension of a patient as nothing else can. From the point of view of the medical attendant, also, there is nothing to be gained by delay; promptness and alertness are qualities to be pursued by him as assiduously as application to study, observation, and thoroughness in a purely professional way.

When emergency cases are admitted to a surgical service promptness on the part of the medical attendant becomes a

matter of necessity rather than of expediency. The loss of any considerable amount of time in the appreciation of a condition of shock by a medical attendant may cost the patient his life; the same applies to a case of hemorrhage. Simple fractures may be converted into compound ones during a delay, and the smoldering clothing of a burned patient may go unnoticed; acid and alkali burns may develop in the interim, and patients may develop respiratory complications if left in draughty areaways for considerable periods of time; unconscious patients may do themselves either active harm in inflicting injuries upon themselves, or passive harm in the development of palsies due to faulty posture.

IV. PREOPERATIVE PERSONAL HYGIENE OF THE PATIENT

In his zeal to give the patient the full benefit of a thorough medical survey as outlined in a previous chapter, a duty which becomes an insistent obligation in case a patient is scheduled for early operation, the surgeon should not neglect the supervision of certain of the more intimate details associated with the patient's personal hygiene, usually falling more strictly within the sphere of nursing care.

The matter of bodily cleanliness is one of especial importance. On the afternoon of admission and previous to being put to bed, the patient should be given a warm bath with plenty of soap and water and should be encouraged to scrub himself thoroughly, especially the creases of his body, and to dry himself carefully with a rough towel, thus loosening and removing the outer cornified layers of the epithelium of his skin together with their contaminating bacteria. If he is to remain two nights in the hospital prior to operation the bath is repeated on the second night, though this time scrubbing need not be particularly encouraged, the main desideratum being an abundance of soap and warm water and subsequent thorough drying.

Oral hygiene should be made a matter of especial attention. The removal of infected teeth or tonsils may be performed

only provided that sufficient time can be allowed prior to operation for the complete local healing of the tissues subsequent to such manipulations. Thorough brushing of the teeth should be encouraged after each meal and especially on the morning of operation. In cases in which oral hygiene is especially poor a mouth wash or gargle may be of considerable value both on the days immediately preceding the operation and on the morning of the operation just before the patient goes to the operating amphitheater.

Male patients should be encouraged to shave regularly during the period of preoperative preparation, and they should be required to shave carefully on the morning of the operation before going to the operating amphitheater.

v. The Preoperative Care of the Bowels

A. Preoperative Starvation: The practice of withholding food for twelve to eighteen hours prior to the performance of abdominal operations, formerly in vogue, has, according to present conceptions, little to recommend and much to condemn it. Emptiness of the gut is not essential or even desirable in cases in which the lumen of the intestinal tract is to be invaded. On the one hand, surgical technique is such as to control the escape of intestinal contents into the general abdominal cavity, and on the other, a collapsed and contracted state of the intestine (a) makes anastomosis unduly difficult of performance, (b) and favors postoperative stenosis of the opening.

B. Food and Feeding: The prescription of sterilized foods prior to operations on the stomach and upper intestine is theoretically desirable, but usually unnecessary, because, in the first place, the oral cavity through which these foods must pass is itself never sterile, and, in the second place, stomach contents and the chyme in the duodenum and upper jejunum are normally sterile, at least to all intents and purposes. Furthermore, and much more important in connection with preoperative starvation, there is always a tendency to the production of starvation acidosis; this is at least a mild danger in

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all cases, but it is particularly a danger in children and in other patients in whom previous morbidity has upset metabolism.

Patients may ordinarily be allowed to eat such articles of diet as are provided in the regular hospital dietary or such food as their particular inclinations may dictate up to the evening meal preceding the day of operation. This meal must be easily digestible, consisting possibly of soup, boiled fish or chicken, spinach, butter, toast, and jelly. Potatoes, cheese, strong tea and coffee, fried foods, and the like are interdicted; no limit, however, need necessarily be placed on the amount of approved foods eaten. Later in the evening if the patient is inclined to be restless and cannot sleep, hot milk, or some other hot drink, may usually be given.

No food is ordinarily allowed on the morning of operation, but water may be freely taken up to an hour or so preceding the journey to the operating room; a cup of hot tea or coffee, sweetened but without cream, may be substituted in case the patient does not relish plain water.

c. CASTOR OIL AND OTHER PURGATIVES: Attention should be paid to the action of the bowels for several days preoperatively. Usually the administration of purgatives or laxatives is not indicated, but liquid petrolatum is preferred as a laxative, if any laxative be needed at all, because its action is purely that of a mechanical lubricant, and its use therefore entails no undesirable or unknown side actions of a pharmacological nature.

Castor oil has been widely used in past years as the purgative of choice for use in the preparation of a patient for operative procedures. The action of this drug is well known; in the duodenum it is transformed into ricinoleic acid which is a powerful intestinal irritant, so powerful that it causes reddening and swelling of the intestinal mucosa and stimulates the muscular coats of the intestine to active contraction, with a resultant relatively complete evacuation of the contents of the intestine.

Granted that intestinal evacuation is desirable in preoperative treatment, a proposition which is by no means univer-

sally accepted, there are, however, two important side effects of such a violent cathartic as castor oil, both of which presumably are undesirable: (1) the irritated condition in which the coils of intestine find themselves after the catharsis, and (2) the inertia of the intestines which invariably follows a period of hypermotility. Mitchell[1] believes the latter to be one of the most fruitful sources of postoperative ileus. In addition to these disadvantages, there is another which is also of importance, viz., the disturbance of the patient's rest, both locally and generally, especially important if purgation is undertaken in the hours just preceding operative intervention.

Castor oil has been mentioned specifically as an undesirable preoperative drug because of the favor it formerly enjoyed, but it is only one of a large group of cathartic drugs which may be employed to the patient's detriment by the uninstructed or careless attendant. Active catharsis is almost invariably best omitted entirely from the preoperative program, but provided that it is to be employed, at least forty-eight hours should subsequently be allowed before operation, in order to give the intestine sufficient time in which to recover from the trauma inflicted. Mechanical cleansing of the lower bowel with enemata some hours before the time set for operation will ordinarily be all that is required as far as the specific care of the intestine, itself, is concerned.

D. THE USE OF ENEMATA: An enema may be given if desired in the evening preceding the day of operation; if administered, it should be given relatively early to avoid disturbing the patient's rest unnecessarily.

On the morning of operation the lower bowel should always be emptied by enema unless some contraindication exists, and this not less than one and one half hours before the time set for operation. If an enema be given subsequent to this time absorption of any fluid inadvertently left within the bowel may be incomplete and the patient's bowels may move on the operating table, an embarrassing and highly undesirable occurrence. In cases of emergency operation neither enemata

nor any other form of intestinal preparation should ordinarily be used.

VI. The Routine Use of Digitalis

Operative procedures by their very nature tend to decrease blood pressure, and as the success of surgical manipulations depends to a considerable extent upon the avoidance of excess depressions, any measure would seem to be of value which might be used to stabilize cardiac action.

Miller[2] and Polak[3] have shown that even apart from the occurrence of shock there is a postoperative decrease in blood pressure of approximately 14.2 mm. of mercury. In postoperative shock, of course, the blood pressure falls much lower still. Apart from the immediate untoward effect of such depressions of blood pressure a variety of postoperative complications are believed to be caused, or at least favored, by vascular insufficiency, hypostatic pneumonia, pulmonary edema, embolism, and thrombosis. The maintenance of normal blood pressure relationships in connection with surgical procedures is, therefore, of great importance.

As has been previously mentioned, in the use of digitalis for purposes of regulating the diseased heart in surgery the usual principles observed in connection with the use of this drug in medical cases are respected. Rapid or slow digitalization may be used depending upon the preferences of the individual medical attendant or in accordance with the exigencies of the particular case, and maintenance doses are regulated with the object in view of obtaining the maximal therapeutic effect of the drug while at the same time avoiding undue toxic action.

The technique of full therapeutic digitalis administration need not be detailed here, as it is discussed very fully in most treatises on the practice of medicine.

The prophylactic administration of digitalis in full therapeutic doses to patients with essentially normal hearts is quite another matter. It has been asserted at various times that digitalis acts beneficially on the normal heart. Thus Geist and

Goldberger[4] believe that digitalization of the normal heart is effective in maintaining postoperative blood pressure, and to this extent prevents the development of circulatory failure. These authors used the slow method of digitalization in their investigations and observed electrocardiographic tracings, as well as the pulse and blood pressure. The normal pulse rate was uninfluenced in normal cases. The average postoperative decrease in blood pressure was only 3 mm. of mercury during the first twelve hours, after which the tension gradually returned to normal.

Other investigations, however, have failed to corroborate these findings. Marvin and others[5] have shown that complete digitalization of the normal heart before operation does not influence the postoperative blood pressure, pulse pressure, or general outcome at all.

In the absence of more convincing evidence than has been presented to date one is almost forced to conclude that in the case of the heart which shows little or no evidence of cardiac failure the exhibition of digitalis probably improves the patient little or none at all. Notwithstanding this, some authors have gone on record as favoring the routine use of *small doses* of digitalis for purposes of "fortifying the normal heart," no attempt being made to obtain full therapeutic effects.

If the use of the drug in full doses is of no value in patients with normal hearts, the use of small doses must be considered quite irrational since Eggleston and others[6] have seemingly shown that digitalis bodies have a negligible effect unless they reach a relatively high concentration, i.e., 1 to 1.5 c.c. of the tincture per 10 lb. of body weight, and apparently the equivalent of 1 c.c. of the tincture is excreted daily even in cases which show congestive heart failure. Accordingly, smaller doses than these would seem to be contraindicated even in cases presenting definite indications for the use of the drug.

Apparently the promiscuous use of preoperative digitalization is not without positive danger; Maynard[7] has reported a case of digitalis intoxication thus produced.

VII. The Use of Narcotics and Atropine

The use of drugs of the hypnotic group preliminary to the induction of general anesthesia has one or more of the following objects in view: (1) to prevent psychic shock, (2) to prevent the development of postoperative lesions in the lungs, (3) to modify or abolish struggling and discomfort during the administration of the anesthetic, and (4) to increase the margin of safety of the anesthetic.

Perhaps the most important function of the preliminary administration of a narcotic is the quieting of the fears and apprehensions of the patient, i.e., the prevention of psychic shock. Probably this indication does not appeal to the average surgeon as strongly as it should, because the surgeon himself, by virtue of his experience, self-confidence, and familiarity with his surroundings, is able very inadequately, and then only as a result of some considerable mental effort, to appreciate the thoughts and feelings of his patient to whom such an ordeal as a surgical operation is the event perhaps of a lifetime, every sight, smell, and sound in the hospital serving to intensify the forebodings of pain and perhaps dissolution. The experience of being led to the gallows or the electric chair could hardly excite more terror for the surgeon than the experience of being taken to the operating room excites in many of his patients; it is by no means uncommon on questioning a patient prior to some operative procedure, which is actually rather trivial, to find that the patient firmly expects not to come through the ordeal alive. Furthermore, unless one has recently experienced the sensations incident to the taking of a general anesthetic at the hands of a none too skillful anesthetist one is hardly in a position to know how actually dreadful this experience can be. It is little wonder that cases are on record in which patients have died merely as a result of fear of such an ordeal.

When Simpson was, for the first time, about to try chloroform on a patient, the orderly who was carrying the bottle fell and spilled it; no other being obtainable, Simpson proceeded without anesthesia with the operation, which was for hernia. The patient died at the first incision.

Later, another patient to be operated upon demanded chloroform; his condition being low, the surgeon feared to grant his wish, but a cloth was held over his face; he took four inhalations of air and died. A third instance is that of a French surgeon, Desault, who drew his finger-nail over the perineum to mark the line of incision, when the patient suddenly gave a cry and died.[2]

Today the fear of operative procedures would be much less likely to result in outright death of patients than formerly, since the popular mind has become better educated in the matter of operative hazards, and the factor of pain has been largely eliminated by the modern methods of anesthesia. However, the only humane, as well as scientific, procedure is to administer opiates in sufficient quantities prior to any operation thoroughly to quiet the patient's apprehensions, unless, indeed, such a procedure is contraindicated for good and sufficient reasons. Doses of morphine of $\frac{1}{6}$ grain or less never do this, in the case of the average adult individual weighing 120 lb. according to Gwathmey[9]; not infrequently a single dose of $\frac{1}{4}$ grain does not suffice; if one uses such doses, there is almost invariably an increase of systolic blood-pressure of 10 to 40 mm. of mercury and occasionally of twice this value, just before the commencement of the anesthesia, showing that the psychic factor has not been sufficiently combated. Gwathmey[9] urges that preceding the administration of any kind of anesthesia for major operative procedures such preliminary medication should be administered as to render the patient indifferent to his surroundings; this applies to local, general, or spinal anesthesia with equal force. When ample preliminary medication has been provided, the stage of excitement is either not noticeable or entirely absent; cyanosis, sweating, and hyperpnea are not prominent, and no increase in blood pressure or change in the character of the respiration should be noted.

Using 7 per cent of ether intravenously, Gwathmey has been able to demonstrate experimentally in animals that (1) anesthesia is induced sooner, (2) less ether is used, and (3) the margin between complete anesthesia and respiratory failure is

widened, when preliminary narcotization has been properly induced.

Using albino rats in two series of cases Gwathmey has shown that distention, edema, and congestion of the lungs, and occasionally, minor or massive atelectases occur in animals etherized without preliminary narcosis, whereas such lesions do not occur in cases in which preliminary morphine (and magnesium sulphate) is used (500 animals). Morphine either alone or in combination with atropine probably sufficiently meets the indications in most cases, but with this view not all authorities agree.

Gwathmey believes that synergistic medication, using a combination of magnesium sulphate and morphine, best meets the indications. Doses of 2 c.c. of a 50 per cent solution of magnesium sulphate have been injected in over 20,000 cases at the Lying-In Hospital of New York, with the production of a negligible number of sloughs (about 7 cases). In favor of combining magnesium sulphate with morphine, Gwathmey cites two parallel series of 200 cases each. In one series morphine alone was used, in the other a combination of morphine and magnesium sulphate; in the first series of cases a postoperative sedative was required, on an average, four hours after operation, in the second series, not for sixteen hours.

Gwathmey advocates the hypodermic use of morphine sulphate, ⅛ grain, dissolved in 2 c.c. of a 50 per cent solution of magnesium sulphate, to be repeated once or twice, according to conditions, at intervals of twenty to thirty minutes. This represents about ¹⁄₁₀₀ of the lethal dose of magnesium sulphate.

Glass and Wallace[10] also advocate a combination of morphine with magnesium sulphate. They believe that the morphine lessens the incidence of intestinal paresis, acidosis, nausea, and vomiting, bronchial and renal irritation, and that the combination with magnesium sulphate usually prevents the necessity of giving additional doses postoperatively.

Smythe[11] and Harmon[12] endorse the method of Gwathmey's synergism warmly.

The preference of Gwathmey and his followers for a combination of magnesium sulphate and morphine, and his contention that these drugs act in a synergistic manner, has been rather seriously criticized.

Von Issekutz[13] thinks that the synergism between morphine and magnesium sulphate is negligible, and Beckman[14] and Sims[15] are also in accord with this opinion. These authors believe that the effect of magnesium salts is additive and not synergistic, and that, therefore, the addition of such salts to morphine is incapable of prolonging the action of the latter drug.

Neuwirth and Wallace[16] have been able to demonstrate that symptoms of the depressant action of magnesium salts occur in the dog only when the serum magnesium content reaches 5 mg. or more per 100 c.c., and that such a concentration is produced only as the result of relatively large subcutaneous injections, 0.25 gm. of magnesium sulphate per kilogram of body weight. Profound narcosis results only after the serum content has been raised to 20 mg. or more per 100 c.c., and this occurs only after the injection of 2.7 gm. of magnesium sulphate per kilogram of body weight. The content of magnesium required for the production of a narcotic action could not be reached when magnesium sulphate or lactate in aqueous solution was given by stomach or by rectum, and two or three injections of 2 c.c. each of a 50 per cent solution of magnesium sulphate failed to raise the serum content much above 3 mg. per 100 c.c. of serum. Such contentions seem to cast some doubt upon the advantages of so-called "synergistic" narcotization, but, of course, do not alter the indications for narcotization by other methods.

With regard to the combination of atropine with morphine little need be said. The combination seems fundamentally rational as (a) the atropine tends to counteract the irritant action of anesthetic vapors, especially ether, on the mucous membranes of the upper respiratory tract, and thus to prevent excess secretion of mucus and saliva, and (b) it is a sort of pharmacological antidote for morphine, many of its actions

being essentially antagonistic to those of morphine. The practice of habitually ordering atropine in conjunction with morphine is, however, apt occasionally to lead one into trouble, because patients exhibit idiosyncrasies for atropine more frequently than for any other drug, and the action of atropine on the heart may prove very alarming in patients with an initial tachycardia.

A combination of morphine with scopolamine would be almost ideal were it not for the idiosyncrasies for the latter drug sometimes manifested by patients; scopolamine, as is well known, in addition to being an excellent narcotic is also an excellent antimenmonic, patients rarely remembering at a later date much that has occurred during the period of action of the drug.

All in all, however, because of the remarkable toxicity of scopolamine in certain cases and its tendency to produce delirium and maniacal states, it is unsuitable for routine use; to this almost all surgeons seem to be agreed, although some authorities regard the contraindications more seriously than others, whereas many surgeons use this combination occasionally in accordance with special indications.

Special indications for the use of scopolamine are usually considered to exist in connection with operative procedures to be performed under local, regional, or spinal analgesia, and the indications are reinforced by apprehensiveness on the part of the patient and by suggestions of inability or disinclination to cooperate.

Bartlett and an increasing number of other authorities feel that some of the newer derivatives of barbituric acid can be made to take the place of morphine or of morphine and scopolamine as a preoperative medication with very material benefit to the patient. Bartlett especially has made a systematic attempt to determine which of these preparations is safest and best, and as a result of careful observations on more than 1100 patients during a period of nine years has decided in favor of luminal. He favors luminal partly on account of the fact that

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it has been in use longer than some of the other compounds and accordingly has been an object to clinical assay for a relatively long period of time, and partly because it is a relatively safe drug as evidenced by the fact that there has not appeared in the literature a "single authenticated death from the use of luminal alone (though single doses of 50 grains have been reported twice)." Bartlett[17] recommends a dose of from 14 to 30 grains, routinely about 15 grains, administered about three hours before the operation is expected to begin; the drug takes effect in about an hour and the effect lasts from twelve to twenty-four hours, sometimes much longer. Such doses of luminal produce a sort of "semi-anesthesia" during which the patient is oblivious to his surroundings, but can be roused momentarily to answer questions or to take water or medicinal agents by mouth; the important cough and "gag" reflexes are not abolished. Furthermore, when the effect of the drug has worn away, the patient remembers little or nothing of the events that transpired during its period of action.

The objection to the use of the barbituric acid derivatives, however, like the objection to the use of scopolamine, is its proneness to show idiosyncrasies. The barbituric acid derivatives occasionally, instead of narcotizing patients, excite them and make them delirious, maniacal, garrulous, and difficult to control.

Sodium amytal, one of the newest of the barbituric acid compounds, is not free from such action; the case of a professional colleague is still fresh in the mind of the author: This very amiable and excellent surgeon required a rectal operation, and having been very favorably impressed with his observations on the action of sodium amytal in his own practice decided to have the drug used in his own case. He received the drug by mouth and within about an hour, he stated subsequently, his memory for all subsequent events connected with the operative seance and the early postoperative period became blank. He talked rationally while going to the operating table, cooperated with the operating room attendants in assuming

the proper position on the table, and appeared quite in posses-
sion of his mental faculties when he was subsequently placed
in bed. He was much surprised, however, to learn much later
that soon after being left alone in bed he became maniacal, rose
from bed, disported himself about in an unclothed condition
with great hilarity and shouted lustily about his local sensa-
tions in a very frank and not altogether elegant manner. He
was restrained with difficulty, and had his operation been of a
different variety might have done himself much harm.

VIII. Last Minute Preparations

Just before sending the patient to the operating room there
are two or three minor matters which require attention.

1. The patient's hair should be confined by a close-fitting
cap or head-dress, the latter being fashioned from a towel or a
piece of gauze. In females, if the hair be long, it should be neatly
and carefully braided and wound about the head under the
head-dress. All hair pins and combs should be carefully
removed.

2. Detachable false teeth, either plates or bridges, should be
removed from the mouth of the patient. Other artificial appli-
ances should, of course, also be removed when possible unless
other factors contraindicate the procedure.

3. The patient should be required to empty the urinary
bladder thoroughly, and if any doubt exists as to his ability or
inclination to do this, he should be catheterized. If, for any
reason the bladder has not been emptied a notation to that
effect should be made in writing by the attending nurse and
should be appended to the chart in a conspicuous place.

4. On leaving for the operating room the patient should
wear a loose fitting garment which hangs entirely from the
shoulders and which can easily be adjusted to expose the area
to be operated upon, usually a hospital gown made of white
muslin, reaching to the ankles and tied together with tapes at
the back. He should be provided with warm slippers and a
dressing-gown if ambulatory, and in any case should be

warmly wrapped in blankets especially in cold or inclement weather.

IX. THE PREOPERATIVE SKIN PREPARATION OF PATIENTS

Formerly it was the preoperative custom to give the skin of any proposed operative area a much more rigorous preparation than is considered necessary or desirable at the present time. On the day preceding the operation the operative area was thoroughly shaved and then scrubbed with a bristle brush and warm soapy water; this was followed by several rinsings of sterile water and the application of a compress rung out of antiseptic solution, commonly bichloride of mercury or potassium permanganate. Just prior to the operation the antiseptic compress was removed, the area was again scrubbed and rinsed, and was further treated with alcohol and ether.

Even with such relatively vigorous preparation the percentage of local infections was discouragingly high, mainly, as is now believed, because during the course of these manipulations the skin received undue trauma. Tissues scraped by the razor blade, scratched by the bristle brush, and then macerated by hours of contact with an antiseptic compress were so devitalized that a suitable nidus of infection was readily established in connection with the added trauma caused by the surgeon's knife.

It is probably quite impossible according to the most efficient methods ever devised to sterilize the skin absolutely. Were the problem merely one of devitalizing the bacteria on a flat epithelial surface, perfect sterilization might indeed be accomplished; but the skin is a complex and irregular structure pierced by innumerable openings leading deeply into its substance, even more deeply into the subcutaneous tissues, and at times penetrating, as in the case of occasional oil glands, to the underlying muscular layers. The sweat glands and the hair and sebaceous follicles are of small caliber and of relatively great depth. Being exposed to contamination from the surface they contain bacteria. Being secretory structures,

however, they contain secretion either in liquid, semi-solid, or solid form. The contained secretion, both theoretically and clinically, serves as an excellent medium for keeping any previously imprisoned bacteria in and the antiseptic out. Since it is probably impossible to effect complete sterilization of such a complex tissue, even though sterility is highly desirable, it becomes necessary to adopt an expedient, viz., that of disinfecting the skin as completely as possible without, at the same time, devitalizing it to such an extent as to impair its natural capacity for dealing with such organisms as will inevitably survive the process.

The best compromise developed up to the present time consists of two parts: (a) the preliminary preparation, which is made usually on the evening preceding the day set for operation, and (b) the final preparation, which is made on the operating table after the patient has been anesthetized and just prior to the commencement of the operation itself.

The preliminary preparation consists of lathering the skin of the operative area well with a good quality of shaving soap, shaving with a sharp razor, washing gently with tap water, swabbing with alcohol, and drying by simple exposure to the air. The area may or may not then be covered with a dry sterile dressing, depending upon circumstances and one's individual preferences.

Such a dressing may prevent gross contamination of the area in certain cases, but patients of limited intelligence cannot be expected to resist the temptation to contaminate themselves with their fingers. Furthermore, especially in warm weather, even a comparatively light dressing may become saturated with perspiration, a circumstance which would make any dressing highly undesirable. All in all, the advantages and disadvantages of the dressing are perhaps equally divided and in view of this, many careful and successful surgeons prefer no dressing at all.

In those cases in which operative procedures must follow directly upon the preliminary skin preparation, water should

be avoided, and dry shaving should be the rule, since anti-
septics penetrate moist tissues very imperfectly. Those which
are relatively insoluble in water naturally do not penetrate
moist tissues well and water soluble drugs become rapidly
diluted by water contained in the tissues and thus rapidly lose
their efficiency.

Final skin preparation consists of swabbing the operative
area with a good fat solvent and subsequently painting it
with a suitable antiseptic solution. In applying the fat solvent
the mistake is often made of proceeding as if the mere applica-
tion of the substance were the desired end. That this is not so
is, of course, self-evident, for the purpose of the fat solvent is
the removal of fat and not merely its redistribution. Conse-
quently, in making use of the solvent sufficient absorbent
material should be used in the form of a swab or "wipe"
to remove the dissolved fat as completely as possible, and the
surface of the absorbent material should therefore be frequently
readjusted or turned so that the dissolved fat may be actually
lifted away from the surface of the skin, and not merely dis-
tributed thereupon. Alcohol is a less efficient fat solvent than
certain other substances, particularly since it contains some
water, and furthermore, being frequently incorporated as an
ingredient in the actual antiseptic solution subsequently used, is
not particularly desirable as an additional preliminary applica-
tion. However, in those cases in which for one reason or another
the skin surface undergoing preparation is already moist, a
preliminary swabbing with alcohol is of value because of its
dehydrating action. The two fat solvents commonly used are
ether and benzene, both of which are mildly irritating, though
to nothing like the same extent as certain other fat solvents,
like xylol, which, because of their markedly irritating proper-
ties, are quite unsuitable for use on the skin. The irritating
properties of the common fat solvents, especially of benzol,
must be remembered, and complete evaporation from the skin
must be allowed to occur before draping of the area is attempted
if disconcerting inflammatory processes are to be avoided.

Ether, of course, evaporates so rapidly that "burns" are not likely to occur in connection with the use of this substance.

Although a host of substances have been devised for final skin disinfection, perhaps there are still no better general skin antiseptics than iodine and picric acid, both in the United States Pharmacopeia. Tincture of iodine in full strength and a 5 per cent solution of picric acid in alcohol (kalmerid) are relatively inexpensive, are non-proprietary, and are almost always at hand or are very easily obtainable. Most other preparations are open to one or more of the following objections:

1. Their value is unproved.

2. They are unduly expensive for routine use.

3. They are under the stigma of unwise exploitation.

4. They stain linen and render it unsightly for subsequent use.

5. They are not easily procurable and compoundable.

6. They are not universally applicable.

Preoperative skin sterilization is a very serious matter and one which should not be made a subject of experiment by the surgeon who is unable to check his results bacteriologically and to assemble a sufficiently large series of cases to make his investigation of real scientific value to himself and of general value to the profession of surgery at large. When skin sterilization is in point, the promiscuous adoption of various new drugs as they make their appearance on the market, and the capricious trial of various combinations of drugs, which may be advocated from time to time in scientific journals, is neither safe for the patient nor rational for the surgeon.

Mercurochrome has gained considerable favor in recent years as a skin disinfectant, but its value is questionable. There is a rather general agreement at present that it is not efficient *per se*, i.e., in aqueous solution.

Simmons[18] found that 2 per cent aqueous mercurochrome solution failed to kill Staphylococcus aureus in ten minutes, killed B. coli in one minute, killed Streptococcus pyogenes in two and one-half minutes, and did not kill Streptococcus scar-

latinae "Dick 1" in five minutes. Aqueous alcohol-acetone 2 per cent mercurochrome solution killed these organisms in one minute, but so did also an alcohol-acetone-aqueous control; a 3.5 per cent tincture of iodine was effective in destroying these organisms also within one minute. Anthrax spores were killed by 7 per cent tincture of iodine in one hour, but by 3.5 per cent tincture of iodine only in from four to ten hours, and not within ten hours by the other solutions. Simmons concludes that a 3.5 per cent alcoholic solution of iodine is superior to any preparation of mercurochrome as a bactericide for use on the unbroken skin, that the aqueous solution of mercurochrome is too feebly bactericidal to be used at all, and that the alcohol-acetone preparation is a comparatively feeble bactericide compared with the United States Pharmacopeia tincture of iodine.

Scott, Hill, and Ellis[19] believe on the basis of experimental study that there are extreme experimental conditions under which neither a 7 per cent tincture of iodine nor a 2 per cent solution of alcohol-acetone aqueous mercurochrome will sterilize the skin, and that a simple 2 per cent aqueous solution of mercurochrome is unsafe for use on human skin because of its too feeble bactericidal power. They conclude, however, that both 7 per cent tincture of iodine and alcohol-acetone aqueous 2 per cent mercurochrome are satisfactory routine antiseptics for skin preparation.

In the technique of skin sterilization certain specific considerations of a mechanical nature would seem to be of sufficient importance to merit brief mention:

1. When planning the extent of the area to be sterilized one should be careful not to err on the side of conservatism. Even the most astute and skilful surgeon occasionally has to incise the skin somewhat beyond the limits which he at first considers sufficient, and although no surgeon could legitimately object to the delay and inconvenience incident to the sterilization of some additional skin area at a considerable distance from the original site of operation made necessary by some unforseen

circumstance requiring a second incision, the original skin preparation must be deemed faulty if provision has not been made for free extensions of the original incision in all directions and even secondary incisions or counter-incisions in adjacent areas. Taking the case of the abdominal operation as an example, and specifically the removal of an appendix, skin sterilization should be sufficiently extensive so that the original incision may be made long enough to provide for a hysterectomy or a secondary incision for the removal of a gall bladder, or a stab-wound for colostomy in the opposite flank, without approaching dangerously near to an unsterilized area. In this connection it must not be forgotten that when sterile drapings are in position on a patient the confines of the sterilized area are not apparent, and the danger of inadvertently encroaching upon unprepared skin in the extension of an incision is not at all imaginary. Ordinarily when the abdomen is to be opened for any purpose no less than the entire skin area bounded by the costal margin cephalad, the symphysis pubis caudad, and a line drawn perpendicularly through the anterior superior spine of the ilium on either side will be sufficient to meet the ordinary emergencies of this type of surgery. In preparing patients for laparotomies all the hair should be removed from the pubic region as a matter of routine.

2. When one is actually engaged in skin sterilization especial attention should be paid to all areas in which the skin is furrowed or thrown into folds; such areas as the umbilicus, the groin, especially in obese patients, the intermammary groove and the inframammary fold in women and the gluteal cleft are illustrative. Care should be taken to insure removal of fat and sebaceous material primarily, and the complete penetration of all such areas with antiseptic solution, secondarily.

3. In applying antiseptics to the skin area with a swab, as is usually done, the part of the skin first treated should be the proposed line of incision; the remaining area should be covered by sweeping the swab in concentric circles from the proposed site of incision outward, never returning to the center of the

area unless absolutely necessary and then only with a fresh swab. As the swab passes over the surface of the skin its antiseptic content is diminished and it also picks up bacteria; only the more susceptible of these are killed really quickly, and if the contaminated swab is repeatedly passed over the proposed line of incision, permanent contamination with very resistant organisms may occur. *Per contra*, the fresh swab not only is itself sterile, but it is saturated with antiseptic solution of undiminished strength.

4. In order to avoid the production of iodine burns, when using tincture of iodine as a skin disinfectant, the primary application of the drug may be followed in several minutes by a secondary mopping with alcohol to remove part of the iodine originally applied; but even this is inefficient provided that the skin area be draped with sterile linen while yet moist. The most important factor in the prophylaxis of iodine burns is complete evaporation of the readily volatile part of the drug prior to the draping.

X. General Remarks and Conclusions

In modern surgery the preoperative care of average good risk surgical patients is rather conservative, as will be noted from a consideration of the foregoing discussion. The change in technique from radical purgation, prolonged starvation, and the exhibition of stimulating drugs to a regime of physiological rest unattended by much actual therapeutic manipulation has been adopted largely as a result of a better appreciation of the causes of postoperative complications and the irresistible argument furnished by the generally smooth and uneventful convalescence of that great class of patients subjected to emergency surgery in which formal preoperative treatment according to previous notions had been impossible. The preoperative preparation of the present illustrates particularly well the principle that in the absence of definite indications for therapy no therapy should be attempted.

There are, needless to say, in the case of many surgical patients very definite indications for active preoperative therapy which have not previously been discussed; for the most part, such patients, however, present special problems which remove them from the class of ordinary "good risk" cases, and special methods for dealing with these problems can best be discussed subsequently in connection with the specific methods themselves. Consequently the preoperative care of surgical patients as considered in this monograph by no means ends at this point.

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CERVICOTHORACIC GANGLIONECTOMY, TRUNK RESECTION AND RAMISECTOMY BY THE POSTERIOR INTRATHORACIC APPROACH*

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ROCHESTER, MINN.

COMPLETE interruption of vasoconstrictor fibers to the arteries of the lower extremities by lumbar sympathetic ganglionectomy and trunk resection has stimulated the development of surgical procedures which would permit equally complete interruption of vasoconstrictor fibers to the arteries of the upper extremities, head, and neck. In order to accomplish such interruption, complete section of the sympathetic nerves to these regions was necessary. Vasconstrictor impulses are carried over the thoracic sympathetic outflow by white rami communicantes, as preganglionic fibers, to end in synaptic connections with ganglion cells in the upper thoracic and cervical sympathetic ganglia. From these ganglia the impulses are carried by postganglionic gray fibers to the arteries, by way of the thoracic and cervical nerves. Intermingled with the vasoconstrictor fibers, are sympathetic fibers, which supply the pilomotor muscles and the sweat glands.

The object of the surgical procedure mentioned is to remove all central influence, and to permit the arteries to dilate to a size larger than normal. Jaboulay and Leriche, in their early work, attempted to bring about vasodilation by periarterial sympathectomy. They expressed the belief, originally, that innervation was centrifugal, and later that it was centripetal. More recently, Leriche and Fontaine still held

that there existed an intramural ganglion which maintained the vascular tonus of the arterial wall. However, Kramer and Todd, and Potts, by anatomic and histologic studies, have shown that this does not exist and that the vasomotor innervation of the arteries corresponds to the musculocutaneous distribution of the spinal nerves, which explains the incomplete results of periarterial sympathectomy.

Royle, in attempting to relieve spastic paralysis, introduced the operation known as ramisection, but since the gray rami are not constant in their origin or distribution it became apparent that fibers were missed at operation. Hence, I proposed and performed ganglionectomy and trunk resection to assure complete interruption of vasoconstrictor fibers. In treating a vasospastic lesion of the lower extremities, I performed bilateral lumbar ganglionectomy, including the second, third, and fourth lumbar ganglia, besides resecting the lumbar sympathetic trunk. This procedure thoroughly interrupts all postganglionic fibers which come from the lumbar ganglia and those which descend through the lumbar sympathetic trunk. Inasmuch as no white rami enter ganglia below the second lumbar ganglion, it might be sufficient merely to section the lumbar trunk below this level if one were certain that stray rami did not descend from above as individual fibers or through the aortic

plexuses. Therefore, I believed it wiser to err on the side of safety, by doing too much rather than too little, since complica-
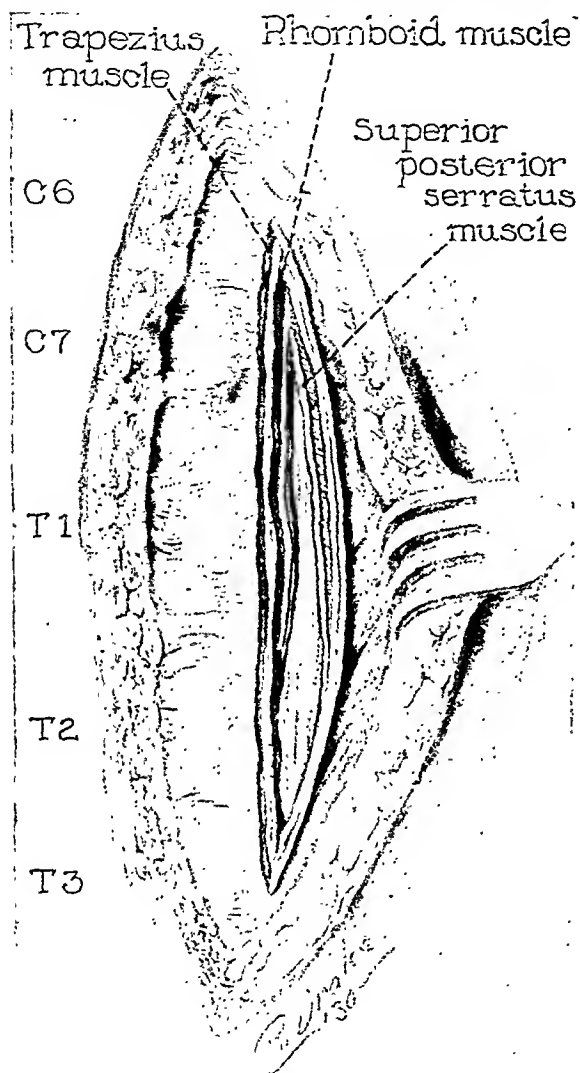

FIG. 1. Skin and aponeurotic incision on right side, preliminary to cervicothoracic ganglionectomy.

tions do not arise from the more extensive operation.

The problem of sectioning all vasoconstrictor fibers to the arteries in the upper extremities has been much more difficult. Jonnesco, in 1916, described a surgical procedure for angina pectoris, by which the middle cervical and the stellate ganglia were resected through the anterior approach. Later, this was employed by Bruening in the treatment of Raynaud's disease

and of scleroderma of the hands. Unfortunately, my experience with the operation in similar diseases has been unsuccessful. Royle's cervical ramisectomy and his later cervical ramisectomy and trunk resection, affecting structures below the first thoracic ganglion, performed through the anterolateral approach, likewise were insufficient to produce complete vasorelaxation of the arteries.

Kuntz, after anatomic studies, explained these failures by the fact that postganglionic rami ascend from the second, and occasionally from the third, thoracic ganglion and pass directly to the brachial nerves without passing through the stellate ganglion. Thus it was obvious that if complete interruption of vasoconstrictor fibers was to be accomplished it would be necessary to resect the thoracic trunk below the second thoracic ganglion, including the first and second thoracic ganglia, in the hope of interrupting all trunk fibers which ascend to the cervical ganglia. In developing this procedure, I learned that Sherrill, in 1910, performed thoracotomy by the posterior approach, resecting the second, third, and fourth ribs in order to ligate the subclavian artery. Henry, also, in anatomic studies, called attention to the anatomic relationships of the subclavian artery and cervicothoracic ganglia following resection of the second thoracic transverse process and rib. Owing to the fact that Raynaud's disease and allied vasomotor disturbances are bilateral, it was necessary to devise a surgical procedure that would permit bilateral cervicothoracic ganglionectomy and trunk resection. This was carried out by me July 31, 1928, at which time I opened the posterior mediastinum after resection of the second rib on each side of the spinal column, removing the second thoracic ganglion and what I believed to be the cervicothoracic ganglion, with the intervening trunk. This, it was hoped, would effect vasorelaxation of the arteries, but it was soon observed that an incomplete Horner's syndrome, with incomplete dila-

tation of retinal arteries, appeared follow-
ing some of the operations. This made it
apparent that sympathetic fibers were

second thoracic ganglia and upper thoracic
trunk. Again, the procedure required more
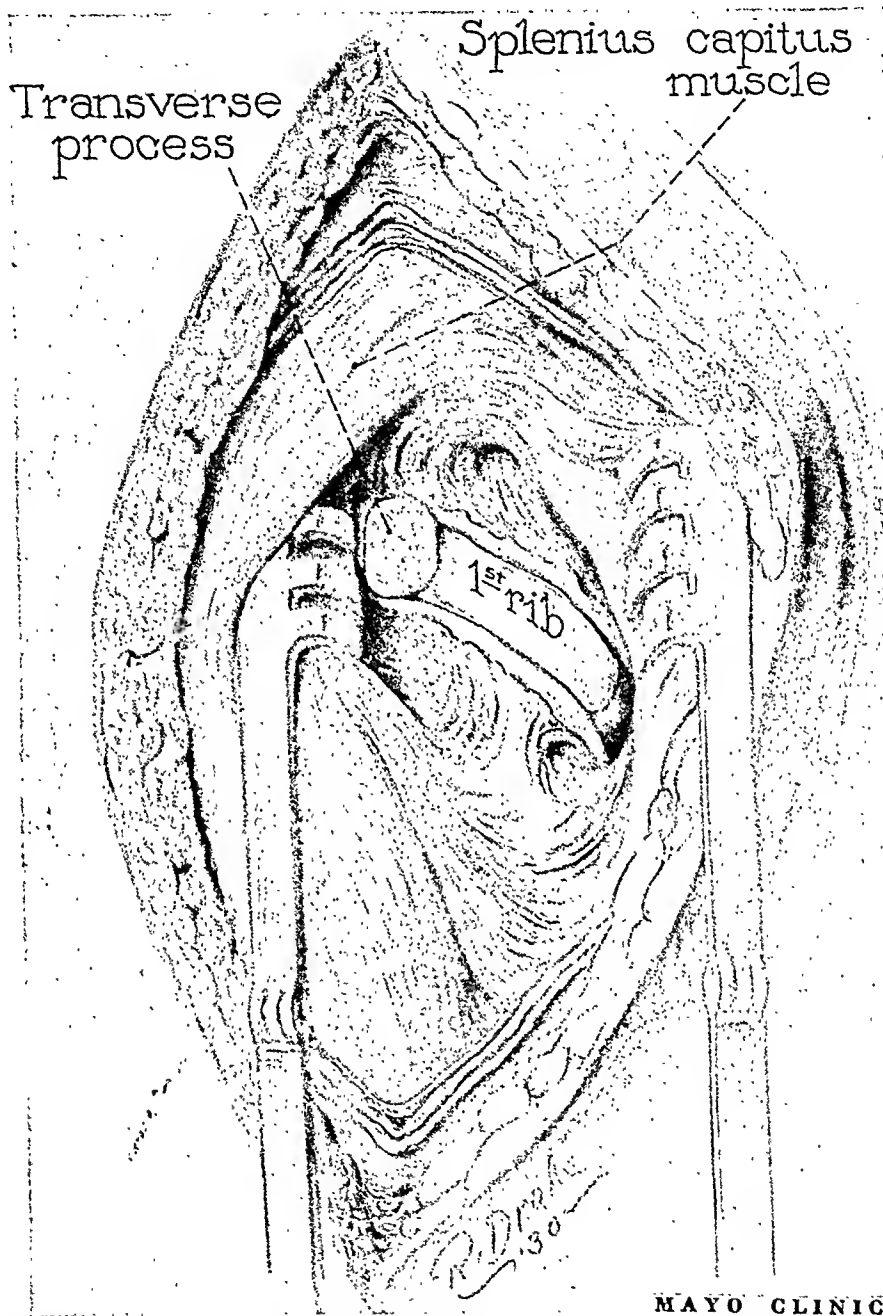extensive resection in order to attain com-

Fig. 2. Exposure of first rib and transverse process of the first thoracic vertebra preliminary to resection.

entering a portion of the lower cervical
ganglia. I learned further that when the
lower cervical and the upper thoracic
ganglia were not fused into a stellate
ganglion, I was removing only the first
and second thoracic ganglia and the
intervening trunk, leaving the lower cervi-
cal ganglion, which was receiving fibers
from some source other than the first and

plete vasorelaxation and uniformity of
Horner's syndrome on both sides. Hence,
the present technique was developed.

This technique differs from the one
described previously[3] in that the thoracic
midline incision is extended upward to the
spine of the sixth cervical vertebra and is
extended downward only to the spine of
the third thoracic vertebra. The medias-
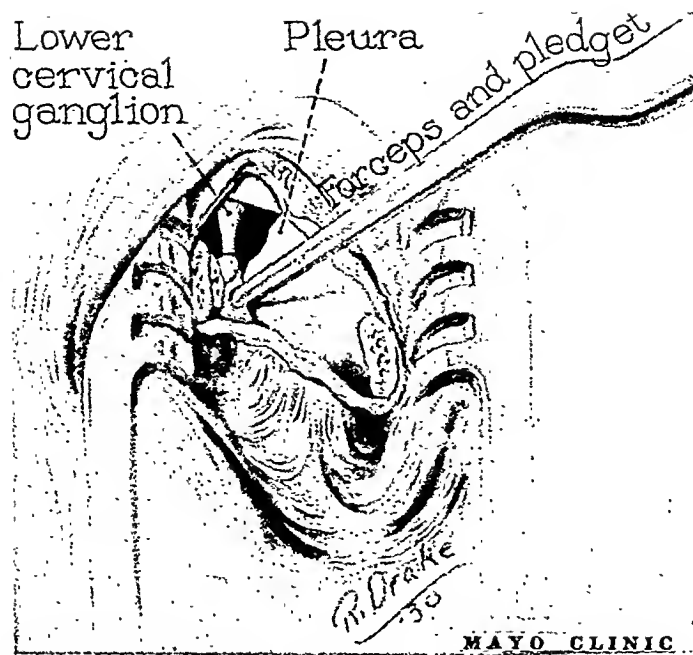
FIG. 3. Dissection exposing thoracic trunk following resection of first rib and transverse process of the first thoracic vertebra.
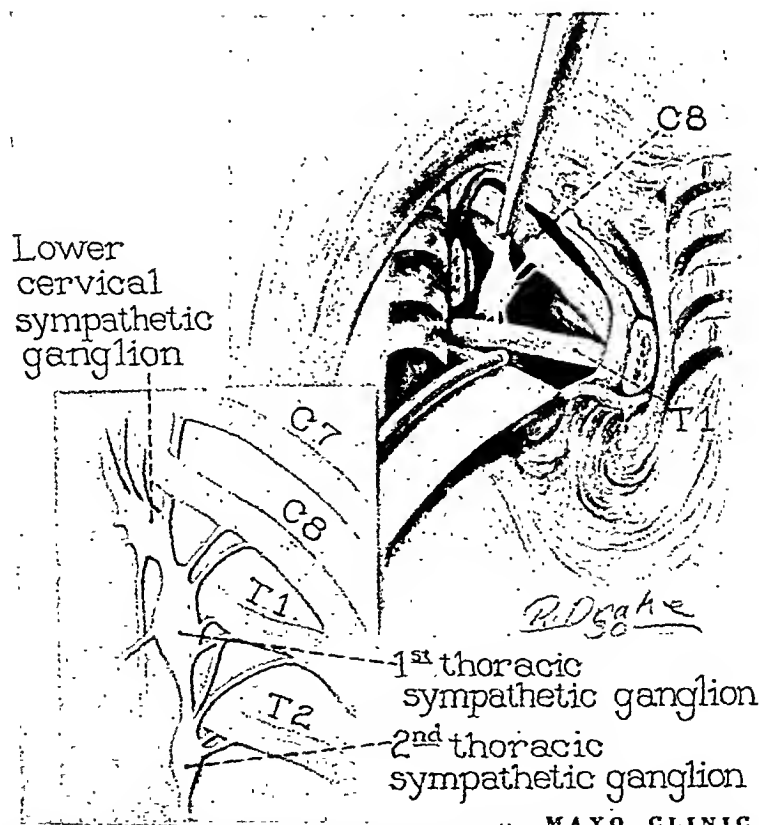
FIG. 4. Delivery of lower cervical and first thoracic ganglia into the wound between the eighth cervical and the first thoracic nerves with schematic drawing illustrating relationship between cervicothoracic ganglia and the brachial plexus.

tinum is entered posteriorly after sectioning the transverse process of the first thoracic vertebra and the proximal portion

In addition, extreme care must be taken to interrupt any stray rami that may pass upward mesially to the thoracic trunk,

Lower cervical and 1st thoracic sympathetic ganglia

C8

T1

R. Drake

MAYO CLINIC
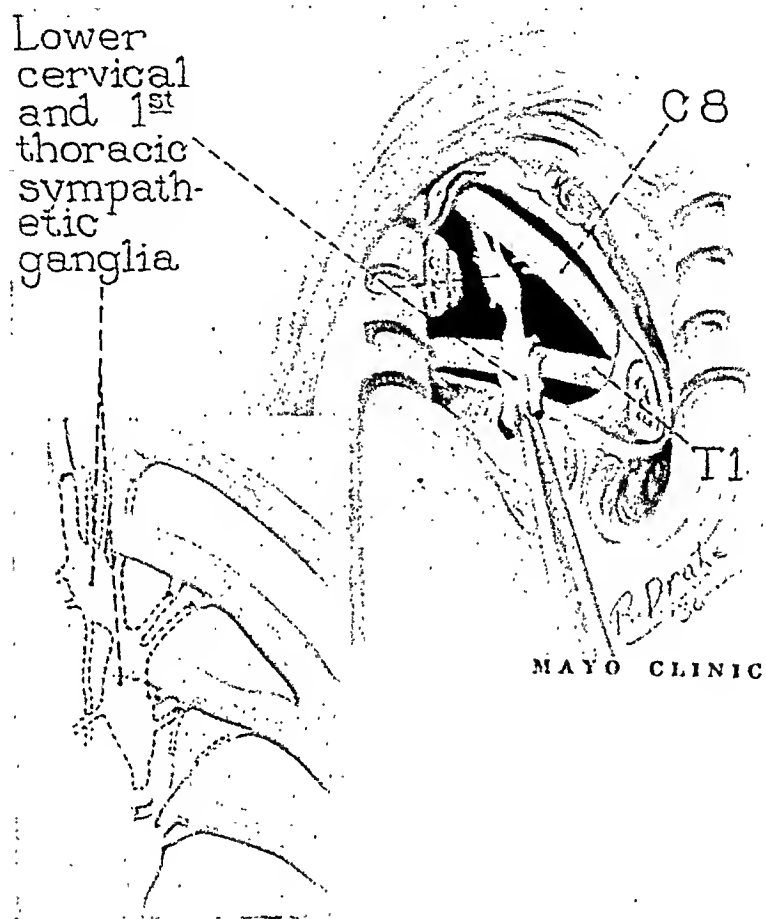
FIG. 5. Resection of lower cervical and first thoracic sympathetic ganglia with the trunk in conjunction with ramisectomy of fibers extending from the second or third thoracic ganglia to the first thoracic and eighth cervical nerves.

of each first rib. This permits one to encounter the stellate ganglion if the lower cervical and the first thoracic ganglia are fused, or to encounter the thoracic trunk between the lower cervical and the first thoracic ganglia if these ganglia are not fused. It assures complete removal of the lower cervical and the first thoracic ganglia with the intervening trunk. However, through this approach, one is not always able to remove the second thoracic ganglion; therefore, to insure against rami from the second or even the third thoracic ganglion entering the lower trunk of the brachial plexus, all rami and branches of the eighth cervical and first thoracic nerves are carefully dissected and interrupted.

ascending from the lower thoracic ganglia into the brachial plexuses.

The results obtained by this procedure, compared with those obtained by the former technique, are better. The Horner's syndrome always has been complete, and the retinal arteries and veins have remained permanently dilated, according to the measurements made by Wagner. Although the vasodilating effects have been extremely satisfactory, and many patients have been cured, suggestions of central vasomotor influence in localized cutaneous areas have appeared. This would indicate that occasionally vasomotor fibers are still missed, and would suggest that they probably passed upward mesially

to the thoracic trunks, or through the cardiac plexuses, to enter the cervical nerves. Thus it will become necessary, probably, in these occasional cases to follow cervicothoracic ganglionectomy with a Royle type of cervical ramisectomy.
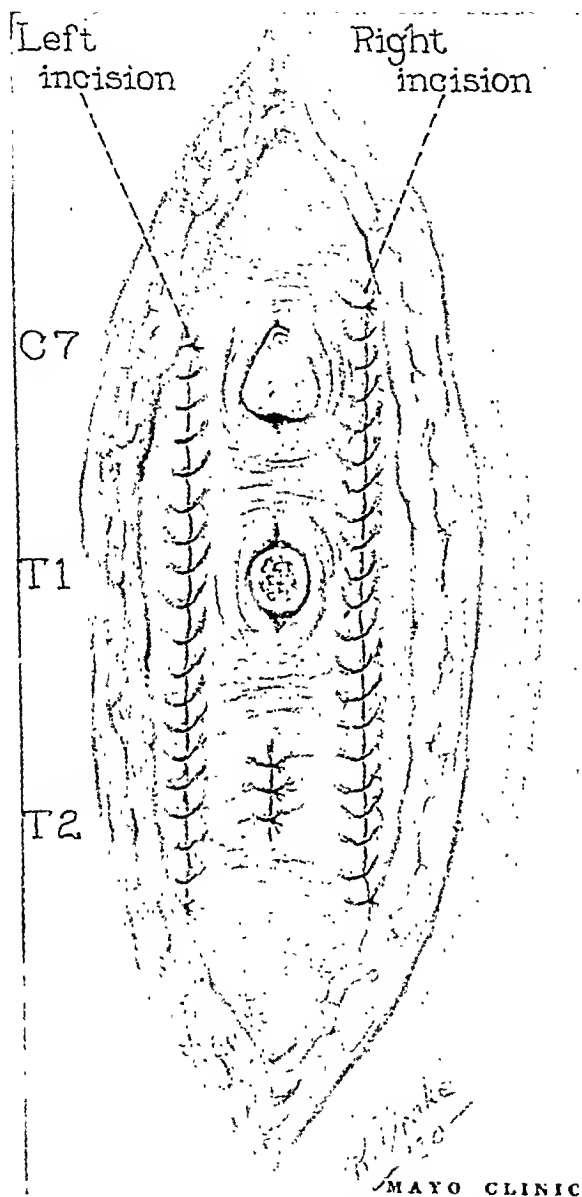
FIG. 6. Partial resection of spines of prominent cervical and thoracic vertebrae during closure of wounds.
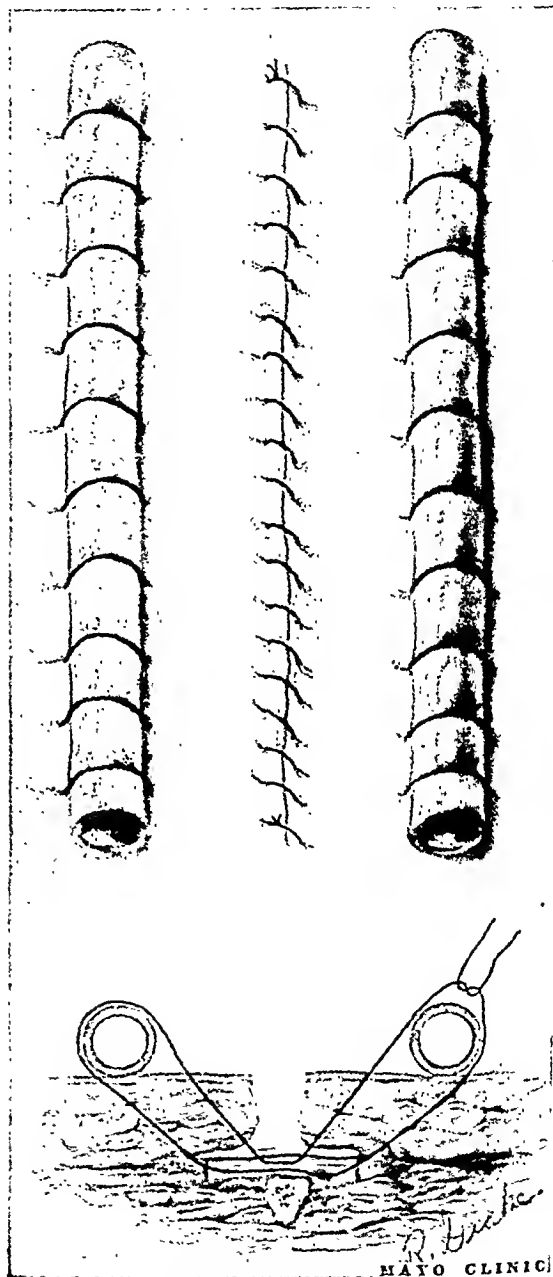
FIG. 7. Closure of skin and fascial planes with dermal and tension sutures.

X-RAY DIAGNOSIS OF DUODENAL ULCER*

PART I

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THE direct study of the local roentgenological appearance of duodenal ulcer in itself, which at the present "bulbusfleck" as a direct sign of ulcer and Haudek in 1911 for the first time emphasized the niche in the duodenum as an

FIG. 1. Woman, aged forty. Brief periodical symptoms of ulcer for a couple of years, worse during the last few weeks. Superficial niche on anterior wall with surrounding slight concavity, only visible in second oblique position. Niche completely disappeared after one month's treatment.

time has nearly everywhere replaced the older, indirect method, by which the diagnosis of duodenal ulcer was based solely on certain functional or secondary gastric signs accompanying it, may be dated back about twenty years when Barclay in 1910 described the persistent indication of an ulcer crater filled with opaque substance.

In the course of the past two decades the direct diagnostic method of duodenal ulcer has had a steady and powerful development and may now be said to have reached a very high degree of precision.

FIG. 2. Woman, aged fifty-three. Symptoms of ulcer for a few months, worse during the last month. In second oblique position a niche formation, the size of a hazelnut, with surrounding alteration of contour appeared on posterior wall of bulb; in other projections one found no bulbar deformities.
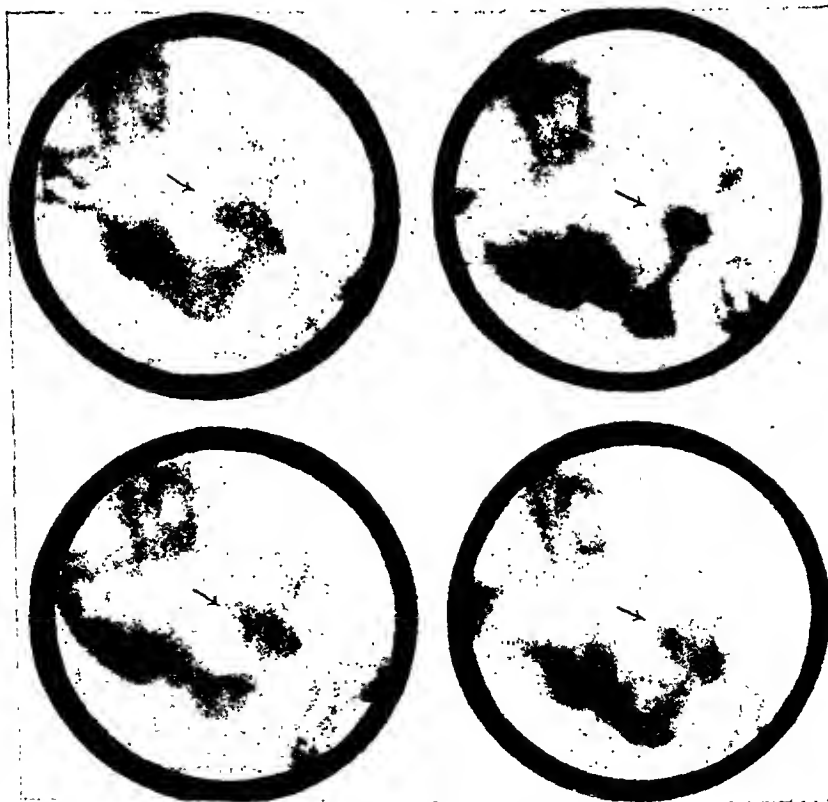

FIG. 3. Serial exposure at intervals of half a minute; focusing and degree of compression previously controlled on screening, exposures then made consecutively without further screening, thus without aiming, in the sense of Berg (not "gezielte Aufnahmen"). Nevertheless the niches appear just as clearly on all the roentgenograms. Recent en-face niche in first oblique position.

In this paper it is impossible to give even a summary account of the development within this field of research in the different

which is used, but also by the extensive personal experience required in order to make a correct interpretation of the details
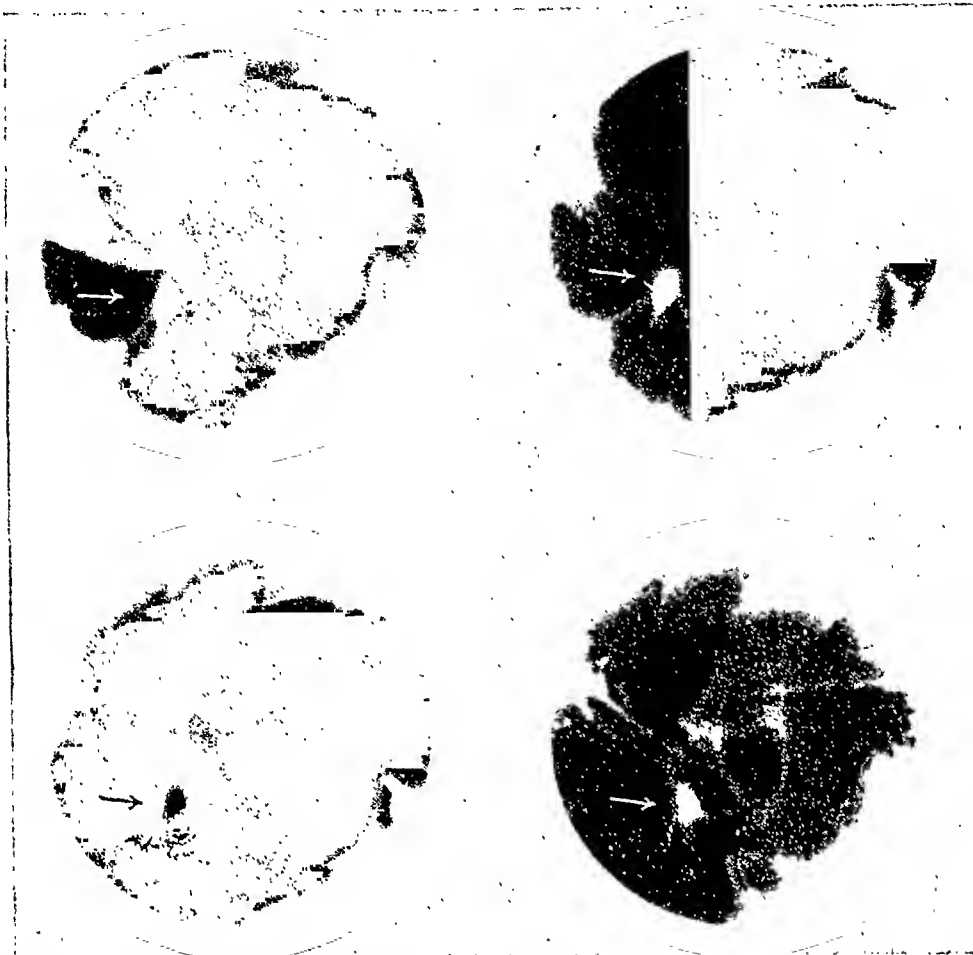

FIG. 4. Serial exposures under same conditions as in preceding illustration. Sagittal projection: Most of bulbar shadow eliminated by compression, niche thus appearing clearly on all roentgenograms.

countries; but it must be admitted that here, as in so many other scientific branches, America took an early lead, and as chief exponents of this phase of roentgen diagnosis mention must be made of three investigators, Cole, George and Carman.

With regard to all historical particulars the reader is referred to the author's detailed work[1] and to H. H. Berg's book[2] both of which include detailed surveys of the literature and bibliographical references.

That this method of diagnosis, so highly developed at the present day, has not yet become available in all its fine points to every radiologist is explained not only by the extremely subtle technique, sometimes both time-consuming and tedious,

in the frequently quite complicated roentgenographic shadows.

Technique. On account of the exceedingly important bearing that technique has on the x-ray examination of the duodenum it will be necessary to deal with this at some length. The reason so many investigators have failed as yet to realize that duodenal roentgenology is one of the most grateful sections within the whole field of diagnosis is above all a lack of knowledge of, and a want of interest in, technical matters.

In a roentgenological study of the duodenum it is more important than in the rest of the digestive tract to *combine intimately screening and filming.*
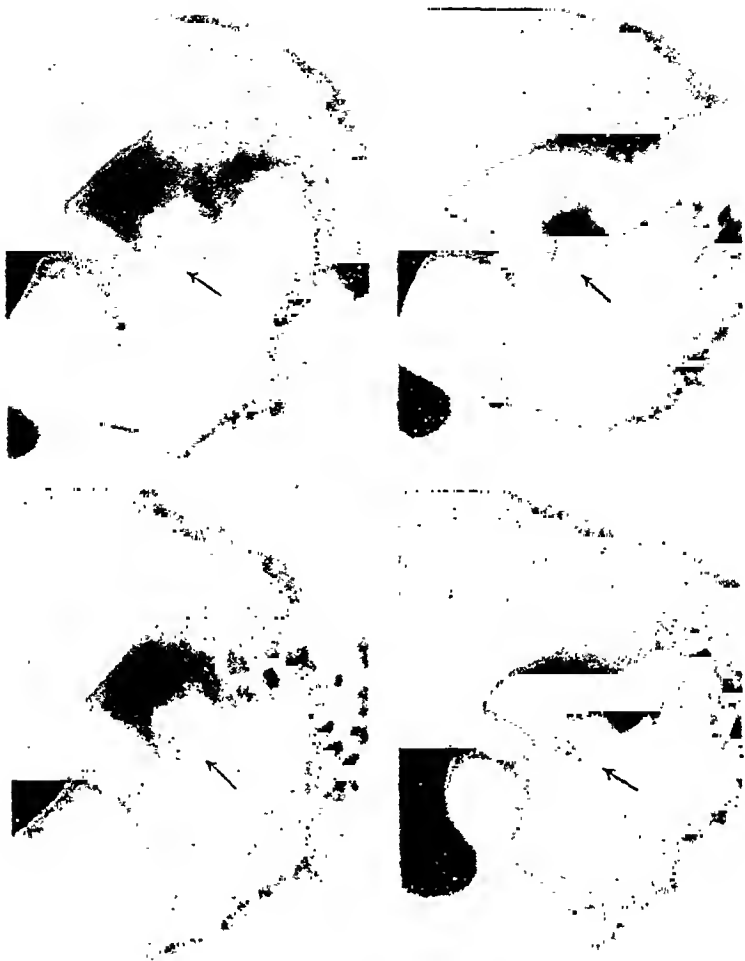
The screening must necessarily be very

FIG. 5. Serial films exposed under same conditions as two preceding ones. Second oblique position: niche on posterior bulbar wall, close to pylorus, visible on all roentgenograms.
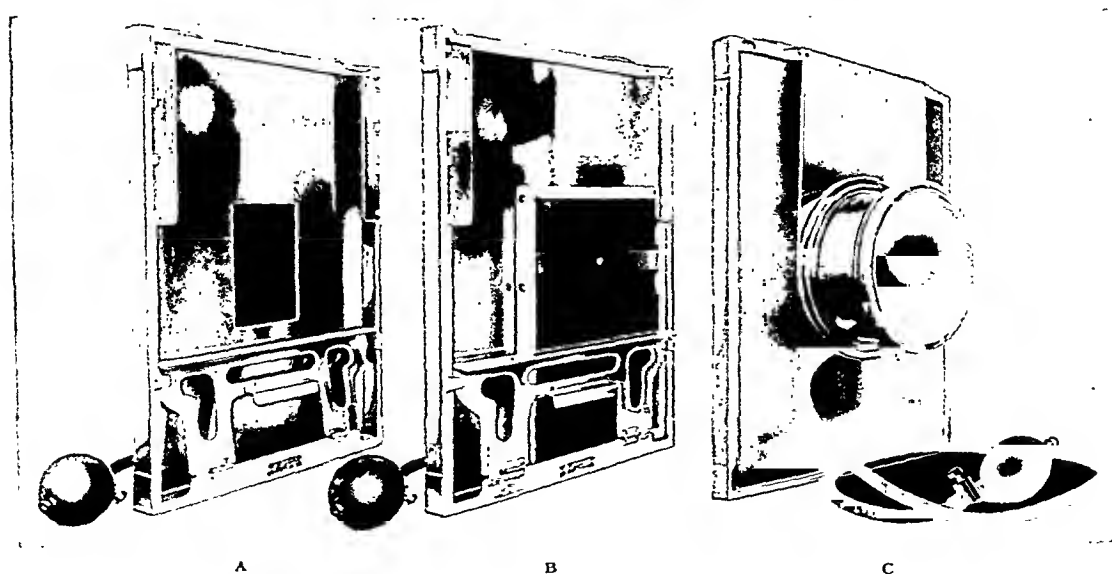

FIG. 6. Serial frame. A. From behind with window visible. B. With casette inserted. C. From front with compression tube and rubber-balloon.

thorough and be used not merely as a general means of orientation before the taking of films: the duodenum must be

most suitable degree of compression having been chosen. *A series of x-ray films exposed under such conditions yield still more*
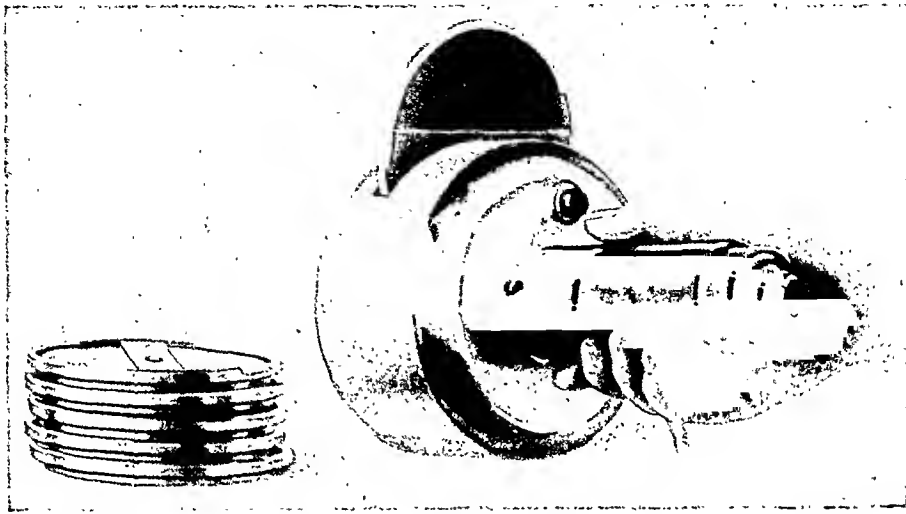

Fig. 7. Spiral diaphragm compressor with round film casettes, one of which is seen partly inserted in diaphragm.

studied on the screen in different positions of the body (upright, supine, prone, oblique and lateral) and with simultaneous *palpation* and *displacement,* as also under different degrees of *compression* and *projections* (best under continuous alteration of projection, Haudek's so-called "fliessende Rotation"). In any case not only should sagittal projections be made but also those with the patient rotated more or less towards the left, the first oblique position, and more or less towards the right, the second oblique position (Figs. 1, 2).

At least one film should be made in every position even if nothing abnormal has been detected during the fluoroscopy and in the case of a suspect or pathological appearance several exposures should be made or serial films exposed in the various positions.

If a good result is desired one must on no account have the exposures made independently of the screening, e.g., with another apparatus or perhaps even in a different room by an assistant.

To get as much as possible out of duodenal films and to make them yield the greatest possible information it is an indispensable condition that *every exposure should be made under direct screening control,* with the best possible projection and the

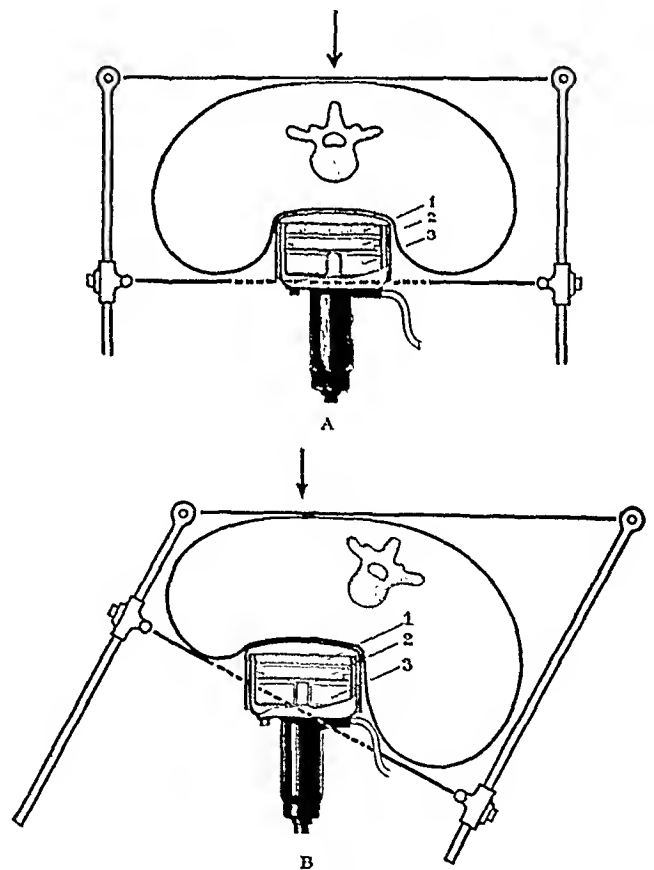

Fig. 8. Spiral diaphragm in compression position, introduced into tube mounted on the casette-holder: A. Direction of projection straight against direction of compression. B. Direction of projection deviates from direction of compression. 1 = spiral diaphragm. 2 = space for casette. 3 = electric motor.

information than the most thorough fluoroscopy; the detailed checking of the film by
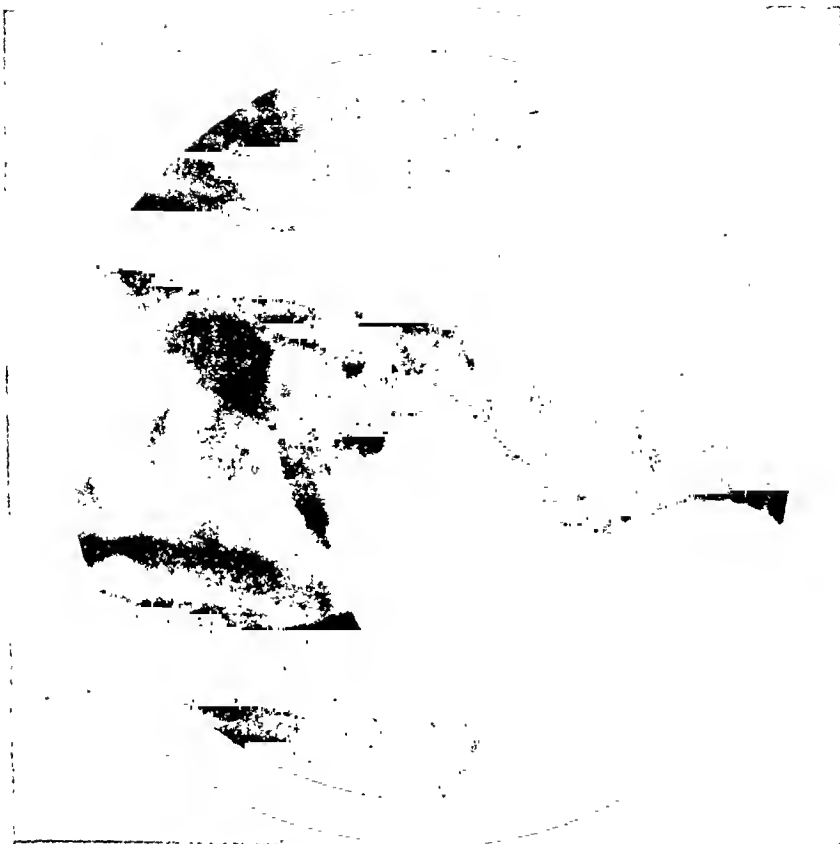
FIG. 9. Niche, size of a linseed, with circular ridge, only visible on films exposed with spiral diaphragm compressor.
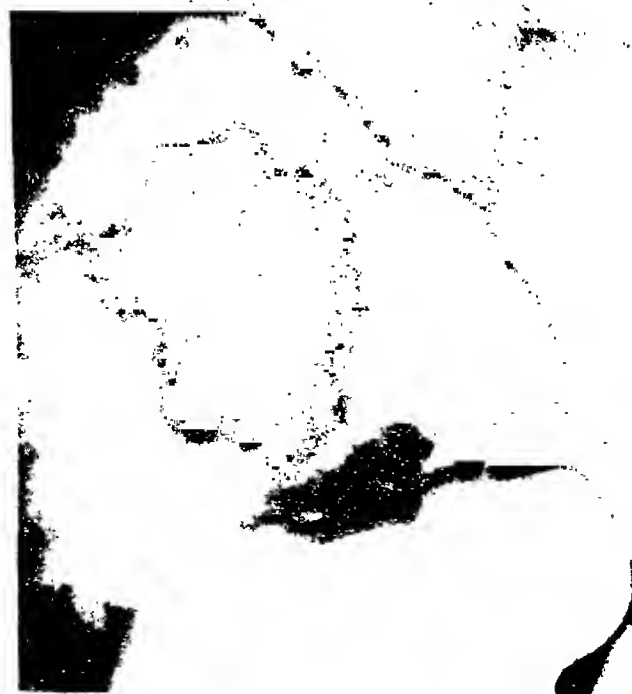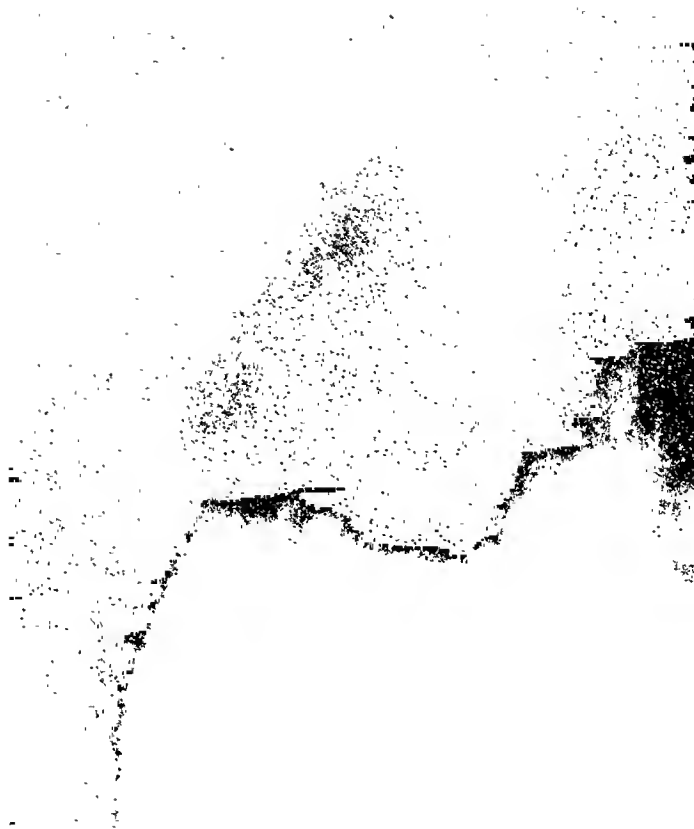

FIG. 10.

FIG. 11.

FIG. 12.

screening is a necessary condition in obtaining such a series.

The requirement for an intimate cooper-

the screening in order to catch on the film precisely that optimum view, that phase in the steadily changing picture when
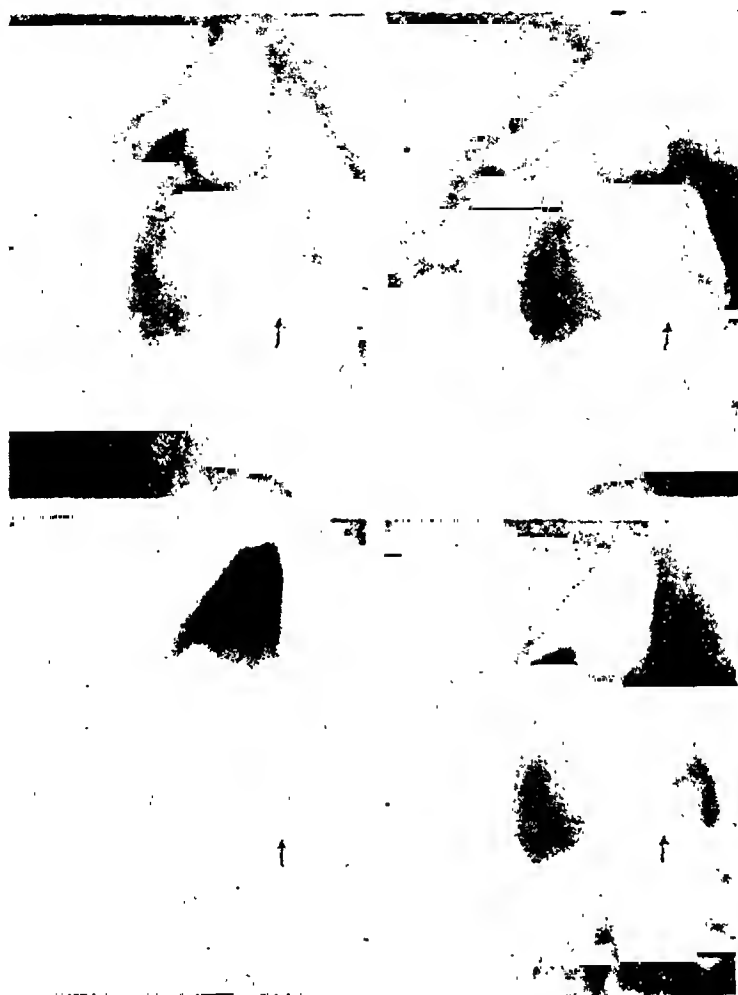

FIG. 13.

FIGS. 10–13. Married woman, aged thirty. Symptoms of ulcer, particularly marked during last week. On Fig. 10 without compression there is no bulbar deformity whatever, on slight compression (Fig. 11) an ill-defined niche can be seen through the bulbar shadow and on strong compression (Fig. 12) niche is distinctly seen, as also on all films of a whole series (Fig. 13).

ation between screening and filming in duodenal examination has resulted in a specialized technique "der gezielten Aufnahmen," the originator of which is the foremost exponent of ulcer radiology in Germany, H. H. Berg. The purpose of this technique is to be able to make an instantaneous exposure by a single movement of the hand whenever desired during

the altered appearance of the bulb is most clearly and distinctly placed in the most favorable projection. This technique requires not only an instantaneous device of transition ("Schnellschalter") from screening to exposure voltage for the x-ray tube but also an equally rapid exchange of the fluoroscopic screen for a film-casette. By the use of a Berg shunter and exchange

frame an exposure can be interposed during the screening in a fraction of a second.

Berg's "geziclte Aufnahmen" have been

can obtain by one or two exposures ideal and exhaustive pictures.
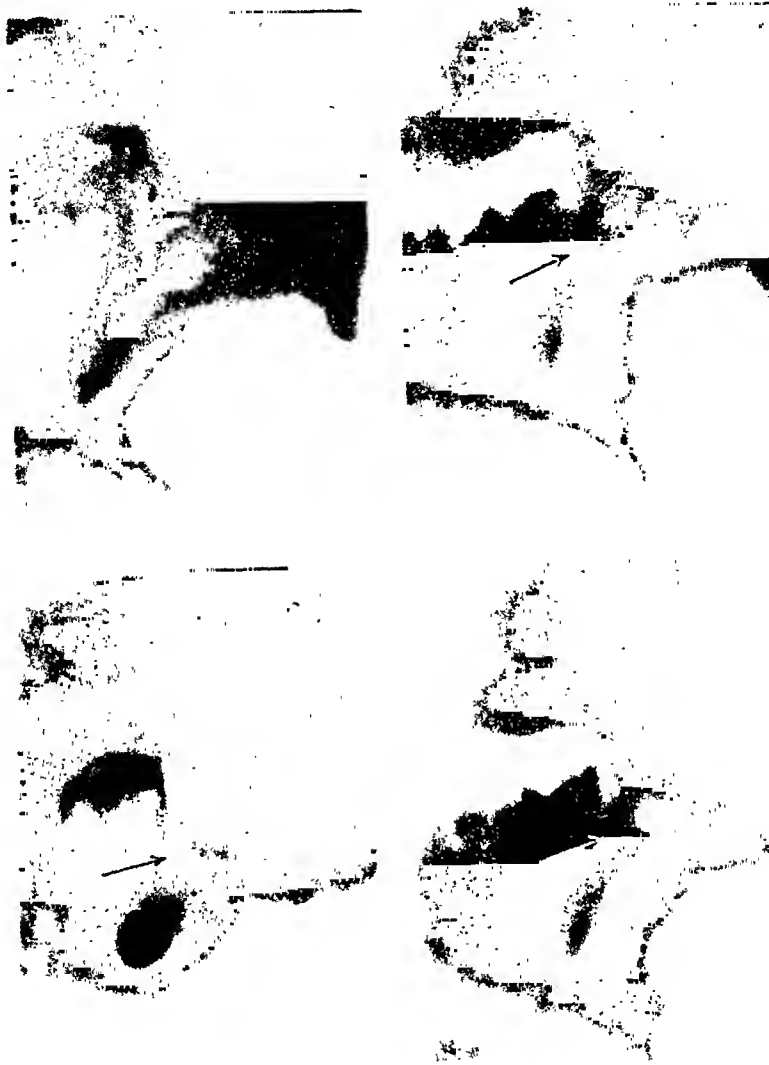
Yet this method has in my opinion a

Fig. 14. First roentgenogram *without* compression shows niche indistinctly through bulbar shadow, other films *with* compression all show an obvious niche.

of great importance in the development of duodenal diagnosis in Germany, not the least of which is pedagogical; this method intensifies and keeps alert by daily training the power of observation of the radiologist in the art of screening; it renders the detection of an ulcer an exciting "shooting" practice and the results obtained by this method are a good indication of the technical skill aquired by the operator. Moreover, the method saves films and is thus very economical: a skillful radiologist

fairly great drawback since it compels the operator to retain his place during the exposure directly in front of the roentgen tube whereby, despite various protective measures, he is more or less unnecessarily exposed to the powerful radiations.

The roentgenograms of the opaque filling of a compressed bulb which are obtained do not usually, however, vary so rapidly as to render it absolutely necessary to make the exposure at an exact moment. Besides, with an unaltered position and

compression an optimal phase of the filling usually returns soon. To an experienced radiologist, therefore, who is not partic-

in height and 9 cm. in width, thus, just a quarter of the surface of the film used. The film-casette is shifted between the
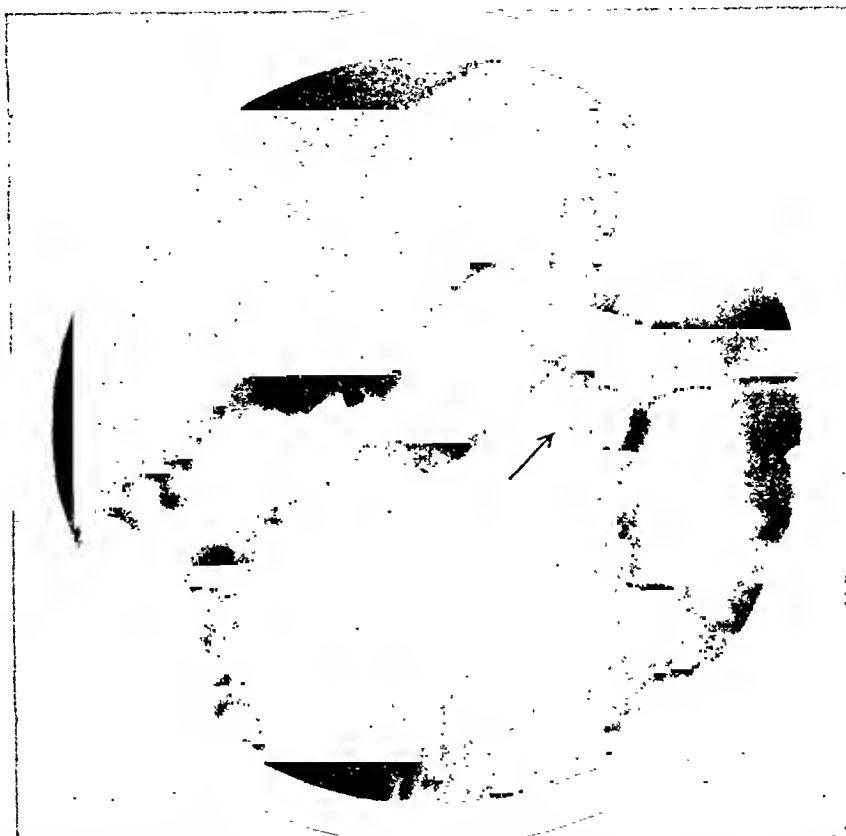

FIG. 15. Married woman, aged thirty-five, with symptoms of ulcer lasting for many years. Without compression no visible bulbar deformity. With compression there is seen a niche, the size of a coffee-bean, close to minor curvature side.

ularly concerned with the reduction of the number of exposures to the least possible, this excellent but dangerous method of "hitting the spot" is not, fortunately, an indispensable condition; by a moderate number of *serial exposures* centered under control of the screen the same practical result can be obtained without having to neglect the demand of efficient protection (Figs. 3, 4, 5).

The device I use for making 4 serial roentgenograms on a 18 × 24 cm. film, is very simple and has only been slightly modified during the past decade. The present appearance of the *serial frame* will be clear from Figure 6. A lead plate is mounted in the frame with a rectangular window in the middle measuring 12 cm.

exposures along the inner border of the frame. When one of the corners of the casette abuts against the corresponding corner of the frame, the diagonally opposite corner of the casette will be directly in front of the window in exposure position. The casette is well supported in every position, in the two upper positions of exposure being supported by a plate with an automatic spring action. The serial frame can be easily adapted to every stand; it need only be hung over the edge of the casette holder. For centering the film the ordinary screen placed behind the lead window of the serial frame is used.

The serial frame is provided with a special tube-shaped "Vordeblende" the screening-off effect of which can be in-

tensified by a series of exchangeable diaphragms, naturally at the expense of the size of the roentgenograms; the smallest compression tube, is pressed tightly against the organ to be examined, in this case the duodenum. The diaphragm is charged

FIG. 16. Niche only visible on roentgenograms taken with spiral diaphragm compressor and with strong compression, but not on numerous other films.

diaphragm gives a roentgenogram with a diameter of 6 cm. The necessary compression can be obtained as desired by the diaphragm tube. A very convenient extra compression device allowing the finest pressure variations is mounted to the serial frame in the form of a rubber balloon; this is placed on the tube facing the patient and the pressure can easily be regulated under screening control by a rubber ball and a discharge valve connected with the balloon by a rubber tube (Fig. 6c).

In duodenal examination I have also used extensively the spiral diaphragm compressor ("Spiralblendenkompressor") described in greater detail elsewhere[1] (Figs. 7, 8). As the name implies, this consists of a small efficient rotatory secondary diaphragm which, enclosed in a

with a series of circular film-casettes having a diameter of about 12 cm. Here, too, the focusing of the film is done under screening control.

The greatest advantages of this apparatus over the afore-mentioned serial frame are that it efficiently shuts off the scattered rays, allows a larger field of exposure and, by avoiding the increased distance between object and film occasioned by the insertion of a tube-shaped "Vordeblende," improves the definition of details.

I have a large series of duodenal cases among which I have been able to demonstrate thinner niches of smaller size on roentgenograms only when roentgenographed with the spiral diaphragm compressor and not on several ordinary serial films (Fig. 9). Nor is there any other

FIG. 17. Normal folds of mucous membrane in duodenal bulb, apparent on correct dosage of compression.

FIG. 18. Compression roentgenogram with normal folds of mucous membrane in duodenal bulb.

method, so far as I am aware, with which one can show such punctiform niches of the size of pin-heads such as I have been

The compression technique has, particularly in the hands of H. H. Berg, been developed to masterly perfection, to which
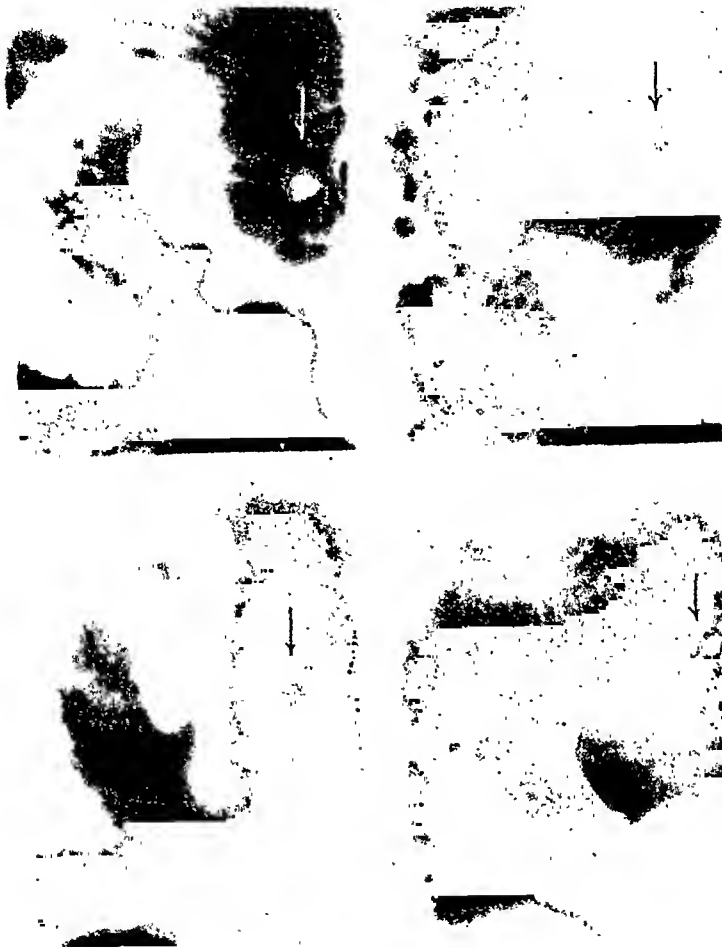

FIG. 19. Bulbar niche with long stalk-like connection with rest of bulbar shadow, perforated on being extracted during operation.

able to demonstrate by this apparatus. On the other hand it must be admitted that this fairly complicated apparatus is just as sensitive and delicate as an ingenious camera: as it is not an apparatus for beginners it requires exceedingly great precision in its use in order to yield good results.

The routine use of *direct local compression of the bulb* is of very great importance in the demonstration of niches. This question has been dealt with in greater detail elsewhere[5] where by a number of illustrations I showed that large niches may be missed by an examiner who does not purposely make use of the direct duodenal compression of the bulb (Figs. 10–16).

the brilliant roentgenographic material in his latest work on ulcers bears witness (1926, 1930).

A suitable degree of compression is a condition essential to a detailed study of the finer changes in the relief of the mucous membrane of the bulb. The degree of compression must be carefully tested or dosed under screening control; too little or too much spoils the picture and the optimum has rather narrow limits. It is a desideratum that the direction of compression too should be made independent of that of projection, at least within certain limits, although these directions frequently coincide. For it sometimes happens that a far better compression record is obtained

if one can apply the compression at a certain angle against that direction of projection which one is compelled to use

it is desirable to have a *primary diaphragm with tubal effect* and with, of course, an adjustable opening. A diaphragm of that

FIG. 20. Man, aged thirty-two. Twelve-year history of ulcer with operation for perforated duodenal ulcer two years ago. Fresh symptoms during last year. Presents double niches on compression roentgenogram, one lower rounded and one upper triangular; in second oblique position these niches prove to belong to anterior and posterior bulbar wall respectively.

in order to get the best possible free-projected roentgenograms of the duodenal bulb (Fig. 80).

Besides the spiral diaphragm compressor and the previously mentioned rubber balloon on the serial frame, I make use of hard cushions or balls of cotton wool of various sizes, and sometimes slices of cork or semi-spheres of aluminum as well. These different compressors are placed between the cassette-holder and the patient; the cassette-holder is fixed in any desired position of compression, also in oblique positions in respect to the direction of projection, by an automatic catch device.

Among other technical devices which facilitate the examination of the duodenum

nature enormously improves the quality both of screening and films. Such diaphragms of different kinds have lately been put on the market, the "step-shaped diaphragm" of Siemens-Reiniger-Veifa's make and the "anti-diffuser-diaphragm" as suggested by H. H. Berg. Not long ago I demonstrated an exceedingly simple device consisting of a cylinder about 20 cm. in length in the longitudinal axis of which a circular diaphragm could be adjusted. With the circular diaphragm farthest back in the cylinder, right against the roentgen-ray tube, the beam of rays let through is sufficiently large for a surveying view of the stomach and duodenum; with the diaphragm shifted as far forward

FIG. 21.

FIG. 22.

FIGS. 21, 22. Man, aged thirty. Periodical symptoms of ulcer for last two years. In first oblique (Fig. 21) projection an en-face niche is seen through center of deformed bulbar shadow, latter showing several defects. In second oblique projection (Fig. 22) where niche appeared as profile niche, it proved to belong to anterior bulbar wall. Operative verification.

Fig. 23.

Fig. 24.

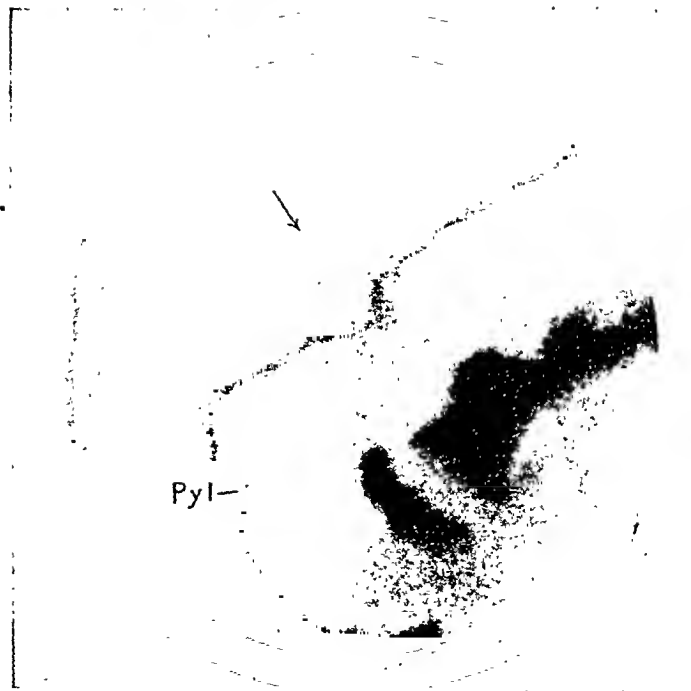FIGS. 23, 24. Man, aged sixty-four. Periodical symptoms of ulcer of many years' standing, worse during past six weeks. Sagittal roentgenogram with compression (Fig. 23) shows en-face niche, size of bean, towards which defects converge from all sides. Film exposed in second oblique projection (Fig. 24) shows niche is plateau-shaped and that it belongs to anterior bulbar wall. Corresponding incisura on posterior wall.
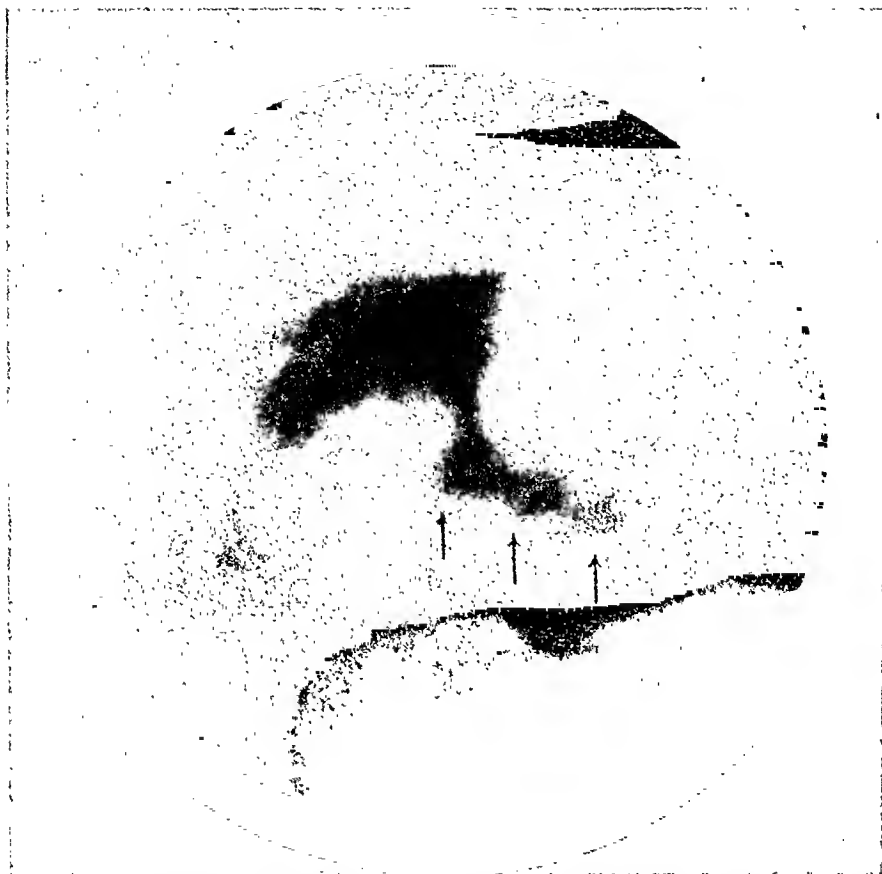
FIG. 25. Man, aged twenty-six. Three years' history of ulcer. On compression are seen three niches, size of peas, located in a row within deformed bulbar shadow.

FIG. 26.

as possible in the cylinder it lets through a beam of rays with a diameter of about 4 cm.

Before leaving the technical details it

The opaque meal must be fairly thin, absolutely homogenous and without any disturbing degree of sedimentation. There

FIG. 27.

should only be added here that duodenal examination requires a roentgen-ray apparatus of sufficient effectivity to need no longer exposure than two to three seconds for obtaining sharp definition of details.

The patient is examined on an empty stomach, or not sooner than four hours after a light breakfast, mainly fluid, and without having subsequently taken any solid or liquid food. Patients with sluggish bowels or a tendency to flatulency are given an enema but no aperients before the examination. Gastric contents on the fasting stomach, if present in any large quantities, should be aspirated before examination.

are several satisfactory preparations of this nature on the market. The simplest perhaps is the suspension of pure barium sulphate in water in a proportion of 3:4 as recommended by H. H. Berg. For my own part I have been mostly using Forssell's thin fruit-juice gruel and in recent years the German preparation "Roebaryt" or Chaoul's "Lactobaryt." I have also tried a number of American preparations without having found any principal difference between them or a general superiority of any one in particular.

The duodenum should be examined in a filled state and also the finer details of the mucous nembrane should be studied in a

contracted as well as in a compressed condition (Figs. 17, 18). The patient having taken only one or two mouthfuls of opaque

It is not always possible to carry out a roentgenological examination of the duodenum strictly according to rules; the
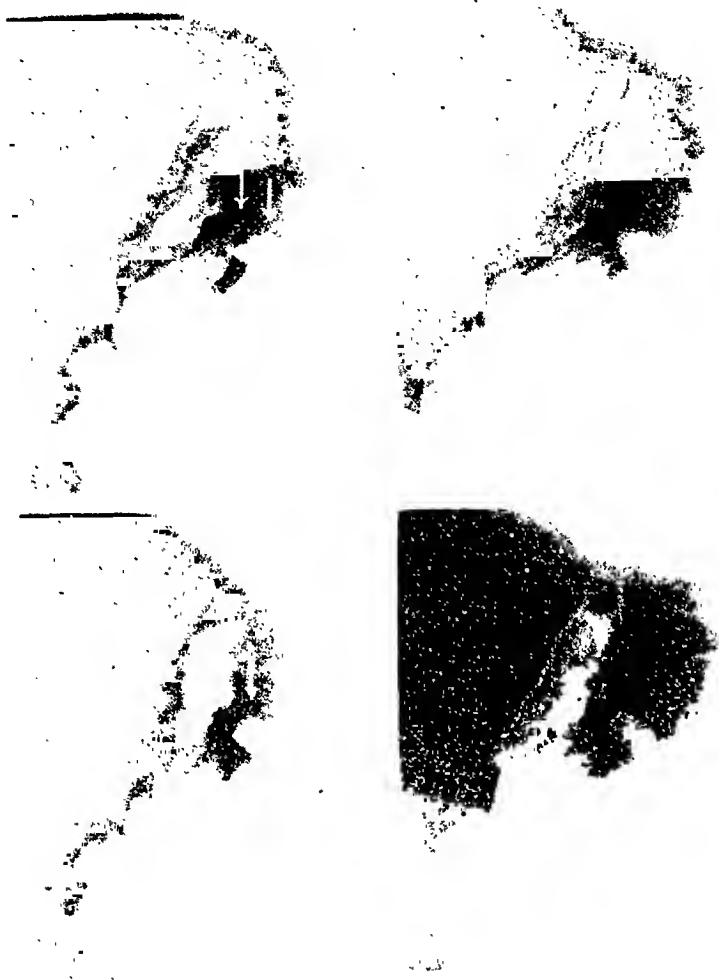

FIG. 28.

FIGS. 26, 27, 28. Married woman, aged sixty-two. Prolonged dyspeptic symptoms. Has lost weight and color, cancer suspected. Without compression no deformity of bulb on sagittal projection. On compression (Fig. 26) an en-face niche appeared, size of a pea, which on oblique films (Figs. 27, 28) proved to be caused by two contact ulcers ("kissing ulcers").

substance, a very good relief film can be obtained by manipulating under screening a sufficient quantity into the duodenum. By suitable compression equally instructive relief films can generally be obtained when the patient has taken the whole of the opaque meal (about 300 gm.). A simple way of getting the bulb well filled is to put the patient after taking the meal into the right lateral position for a few minutes or, in exceptional cases, somewhat longer. The filling can be improved by manual expression, repeated if necessary several times in succession.

radiologist must learn to individualize according to the circumstances of the case.

The most important examination and the one that yields most information is generally that with the patient in a standing position; it is best to begin with this position. Surveying films are first made followed by a series of special exposures; one then proceeds with the various reclining positions in which surveying films are generally sufficient, but in certain cases it is also necessary to make serial exposures.

As a rule, in every examination of the

stomach or duodenum, besides the survey-
ing films in standing, supine and prone
positions, I expose at least one group of

this technique be carried out in fifteen
minutes in simple cases and in complicated
cases in thirty minutes at the most, not

FIG. 29.

serial films (4 exposures) either in the
sagittal projection or under rotation of the
patient more or less towards the left (first
oblique position) and at least one series
with rotation of the patient towards the
right (second oblique position); thus ob-
taining at least two series of films in pro-
jections more or less at right angles to
each other. In case the findings are indeci-
sive other films are immediately exposed.

It is made a rule never to make roent-
genograms without having first paid careful
attention to position, extent of filling,
compression and projection under screening
control.

It might seem that such an examination
would prove in practice far too tedious and
time-consuming but that need not be the
case. With increasing experience and prac-
tice a duodenal examination, including
examination of the stomach, can with

including, of course, the time occupied
for subsequent analysis of the films and
the making up of the report.

Direct Ulcer Signs. Of roentgenogically
demonstrable local changes produced by
an ulcer in the duodenum those concerning
the shape of the duodenum are un-
doubtedly the most important, being the
most constant and characteristic. Since
the duodenal ulcer is, according to exten-
sive statistics in far the majority of cases
(Gruber, 83 per cent, Collin, 92 per cent,
and Mayo, in 99 per cent), localized to the
first onion-shaped, dilated part of the
duodenum, it is therefore the alterations
in shape within this part, the "bulbus
duodeni" (Holzknecht) or Cole's "cap
of the stomach" that constitutes the cen-
tral point in the direct roentgen-ray
examination of duodenal ulcer. Compared
with the *deformities present in the bulb*,

the other local changes roentgenologically demonstrable, which a duodenal ulcer may produce, play a very subordinate part in the definite diagnosis of ulcer; but on the other hand these changes referring to the *size, position, direction, displaceability, motility and sensitiveness to pressure* of the bulb, may offer certain valuable pieces of specialized information in the clinical estimation of the case.

Before we enter into a closer analysis of the deformity of the bulb produced by ulcers the following question may be raised: *Is every ulcer of the bulb accompanied by a deformity demonstrable by roentgen rays?*

On the strength of the experience I have accumulated in the course of more than twelve years of fairly intensive practical work in this special field, I should like to answer the question thus: Every open ulcer of the bulb which extends more deeply than the purely superficial defects of the mucous membrane in fresh acute ulcers causes an alteration in shape or outline of the opaque contents of the bulb, which by the help of an exquisitely careful technique (such as that already described), when practiced by an experienced radiologist, is practically always roentgenologically demonstrable. It stands to reason, of course, that under conditions particularly unfavorable for an examination, such as cases of marked adiposity, or in case of incomplete examination, as in patients greatly weakened by loss of much blood or a long stay in bed, or otherwise delicate in health, smaller changes might at times be missed by the examiner.

It is quite certain that single entirely normal films of the bulb or a whole series of normal films exposed in a certain projection and perhaps without compression do not justify us in excluding a deep duodenal ulcer (see Fig. 2, 10–16). It has been long known that with the bulb filled to a certain extent and with the roentgenogram made at a certain projection even a chronic indurated ulcer may very well be hidden and the bulbar shadow present quite a normal appearance. In order to be able to exclude a deformity a close analysis of the bulbar area, made by screening under palpation, compression and continuous

FIG. 30.

FIGS. 29, 30. Woman, aged forty-three. Periodical symptoms of ulcer for the past eighteen months. On sagittal compression film (Fig. 29) with sufficiently strong compression to eliminate the rest of the bulb, two niche formations, the size of peas, appear partly covering each other. In second oblique projection (Fig. 30) niches proved to be situated opposite each other on anterior and posterior bulbar wall respectively ("kissing ulcers").

change of position (Haudeks "fliessende Rotation") and also by different series of roentgenograms made with suitable compression in various projections, is required.

When a deformed bulb has been demonstrated it must be subjected to a *detailed analysis* regarding its *shape;* it is not enough to be content as formerly with a general description and to liken it to some common form such as a clover-leaf, coral branch, pine branch, butterfly and the like. It is a question of analyzing the different form-components entering into the deformity and, if possible, trying to form an expression of the pathological-anatomical or functional basis of these different components.

These different components, which to-

gether may make up a roentgenological ulcer deformity of the bulb, and which may occur either separately or in different

forcing its way into and filling out the pit-like defect or crater-formed depression in the wall brought about by the ulcer, is thus

FIG. 31. Married woman, aged thirty-one. For past two years brief periods of epigastralgia. On compression were seen two niches, partly covering each other on roentgenogram and surrounded by a wallshaped defect ("kissing ulcers").

combinations, and which may also to some extent pass over from one to another, may be arranged in the following groups:

(1) Niche formation.

(2) Narrowing, indrawing, pursing-up, sulcus or incisura formation, defect in the bulbar shadow, thus more or less pronounced *transverse* encroachments upon the lumen of the bulb.

(3) Loss of convexity, flattening, shortening, retraction of the bulbar outline, thus mainly *longitudinal* restrictions of the bulbar lumen.

(4) Pouch formation, saccular dilatation, diverticula.

(5) Annular, ridge and star formation (relief deformities).

(1) THE ULCER NICHE. The ulcer niche, produced by the opaque substance

the direct roentgenological sign of loss of substance in the duodenal wall occasioned by the ulcer. Both from a theoretical and practical point of view the niche is not only the most important but also the most reliable and frequent direct sign of ulcer.

In many cases both experienced and modern authors, and undoubtedly also a great number of practicing radiologists still maintain that the presence of a niche in a case of duodenal ulcer is a fairly great rarity and that it lacks any great practical importance. Nothing can be more erroneous and such a view marks the technique employed in the individual case as both unsatisfactory and unreliable.

In my first tabulated account of any larger compass (1921, about 100 cases) of definite duodenal ulcers the niche was

present in more than 60 per cent.[6] These 60 cases, at least, of niche formation had been collected in two years. After another

Berg in a large number of cases and also subsequently by other authors.

The anatomical *cause* of the niche is

Fig. 32. Man, aged thirty-seven, with ulcer symptoms of many years' standing, at first for brief periods, lately more persistent. "Kissing ulcers" of more unusual localization, larger of two on lateral, smaller of them on medial bulbar circumference.

two years (1923) the cases of niche formation observed by me had increased to about 250 and at present (1930) they greatly exceed a thousand. With the present routine compression technique, I estimate that of my cases of duodenal ulcer definitely established radiologically, roughly 75 per cent at least have at one time or another given evidence of niche formation. For long periods, especially in the spring and autumn it is not now unusual for me to see on an average one or two niche cases of duodenal ulcer daily, while in the same material I come across perhaps one niche of the stomach every or every other week. I had the pleasure of seeing my view about the great frequency and eminent importance of the niche in cases of duodenal ulcer fully confirmed in 1926 by H. H.

seldom a penetrating ulcer (such are on the whole rare in duodenal cases, Fig. 19), but more often a callous or indurated ulcer situated in the duodenal wall itself. A less common although by no means rare phenomenon is to find a clear niche formation roentgenologically in cases of more recent non-indurated ulcers even when on exploration no demonstrable changes of the outer side of the intestinal wall either on inspection or palpation are found. One would wish that surgeons always kept this fact in mind. In one or two exceptional cases I have also come across, as an anatomical cause of a niche formation in the bulb, an epithelialized pit-like depression in the duodenal wall persisting after the cure of the ulcer.

The *size* of the bulbar niche varies

considerably. The largest I have seen were the size of half a walnut and the smallest the size of a millet seed, or even punctiform.

level of the opaque contents of the niche appear in contrast to the non-opaque fluid above.

FIG. 33.

The *shape* varies in profile from a semisphere to more the appearance of a nipple, tap, tent or thorn. On a frontal view the niche has generally a rounded appearance, sometimes more elongated; not unusual, particularly on compression roentgenograms, are the angular forms, the three, four or many-cornered, jagged or star-shaped forms with the corners often extending into the sulci between the folds of mucous membrane surrounding the niche (Fig. 20).

Particularly on compression roentgenograms, but also on others, the niches are usually found to be *denser* than the rest of the opaque shadow. *Gas bubbles* and a *three-layer separation* of the contents do not commonly occur; such phenomena, however, need not imply penetration but occur in purely intramural niches in the same way as the more common *horizontal*

The bulbar niches are usually *localized* in the basal half of the bulb; within this area they are most common at a certain distance from the pylorus and are less frequently met with at the pylorus itself and its immediate surroundings. The niches are also quite rare in the distal half of the bulb and more so the farther away one goes from the pylorus. Regarding the localization of the bulbar niches it is further true that they are decidedly more common in that half of the bulbar circumference that belongs to the area of the lesser curvature, thus within the medial respectively upper or left half, than within the lower or right half which belongs to the area of the major curvature. On the other hand I have been unable to find any preponderance in favor of the anterior or posterior wall of the bulb.

It is, of course, quite clear that the niches

which in a certain projection appear as "profile" or contour niches, in another projection more or less at right angles to

in the bulbar wall itself or in its suspensory ligament) appears in a pure sagittal projection in profile on the lesser curvature

FIG. 34.

FIGS. 33, 34. Woman, aged twenty-seven. Periodical symptoms of ulcer of many years' standing, this time for a month. Compression roentgenogram (Fig. 33) shows an en-face niche, size of a pea, with surrounding infiltrated ridge. Otherwise no deformity. After treatment there only remains a slight part of the niche (Fig. 34).

the first, appear as "en-face" niches or vice versa. The terms "profile" and "en-face" niches thus convey nothing in themselves as regards the localization of the niche on the circumference of the bulb; for an exact localization attention must also be paid to the direction of the projection employed (Figs. 21–24). In the case of an "en-face" niche being found one should always, if possible, try to get a free-projected view of it; in other words, by altering the projection one should place the niche in profile, thereby ascertaining its position on the circumference of the bulb.

It is not so rare that, particularly in chronic callous cases, a niche formation on the anterior or posterior wall of the bulb (mainly on account of cicatrization

aspect of the bulb or at least partly projects beyond this contour. It is generally possible, however, as has been rightly emphasized by Berg, to convince oneself by making a roentgenogram in the second oblique projection (see preceding) whether such a niche really belongs to the lesser curvature itself or whether it is part of the anterior or posterior bulbar wall.

It happens not infrequently that by this technique of projection and compression *double* or *multiple* niches can be demonstrated in the bulb. In the case of *multiple niches* one of them is generally found to be larger, deeper, of older date and more indurated; it, so to speak, puts its mark on the whole type of deformity and attracts the interest of the examiner. The presence of an ulcer of larger size often prevents

simultaneous ulcers of a smaller and more superficial type from making themselves apparent in the ordinary characteristic manner so that they may be diagnosed. Also the films may readily become so complicated that one must often be contented with assuming the presence of one or several ulcers of smaller size, as well as the larger one. In such a case a definite establishment of multiple ulcers is of course of no great importance from a practical therapeutical point of view. In other cases where the niches are more of the same size it is not unusual to be able to demonstrate several niches, especially when employing a good compression technique. In several instances I have managed to demonstrate both three and four simultaneous niches (Fig. 25). The *double ulcers* of Moynihan's type, the "kissing ulcers," the contact ulcers, are relatively easy to bring out on account of their characteristic position. The "enface" niche appearing in a sagittal projection proves on oblique projection to be a combination of two niches projected one above the other, and in the second oblique

Fig. 35.

projection one of the niches is found to belong to the anterior and the other to the posterior bulbar wall (Figs. 26–32).

Under roentgen control by periodic examinations, e.g., in the course of medical treatment, the niches prove to undergo fairly rapid *changes in size*. As a rule during a cure a niche diminishes considerably or perhaps entirely disappears. It is often quite astonishing to see a niche about the size of a pea nearly entirely disappear in a couple of weeks. Routine control examinations of the results of medical treatment would seem well justified (Figs. 33–36).

Before leaving the niche as a sign of ulcer a few words should be said about the factors that may prevent the niche from appearing in the case of smaller ulcers. The ulcer may be covered by thick folds of mucous membrane; deposits of mucoid material, blood clots and food debris may

fill out a shallow ulcer crater and thereby prevent the opaque fluid from entering it. According to Berg the local swelling of

demonstrate these ulcers, so often fairly superficial and recent.

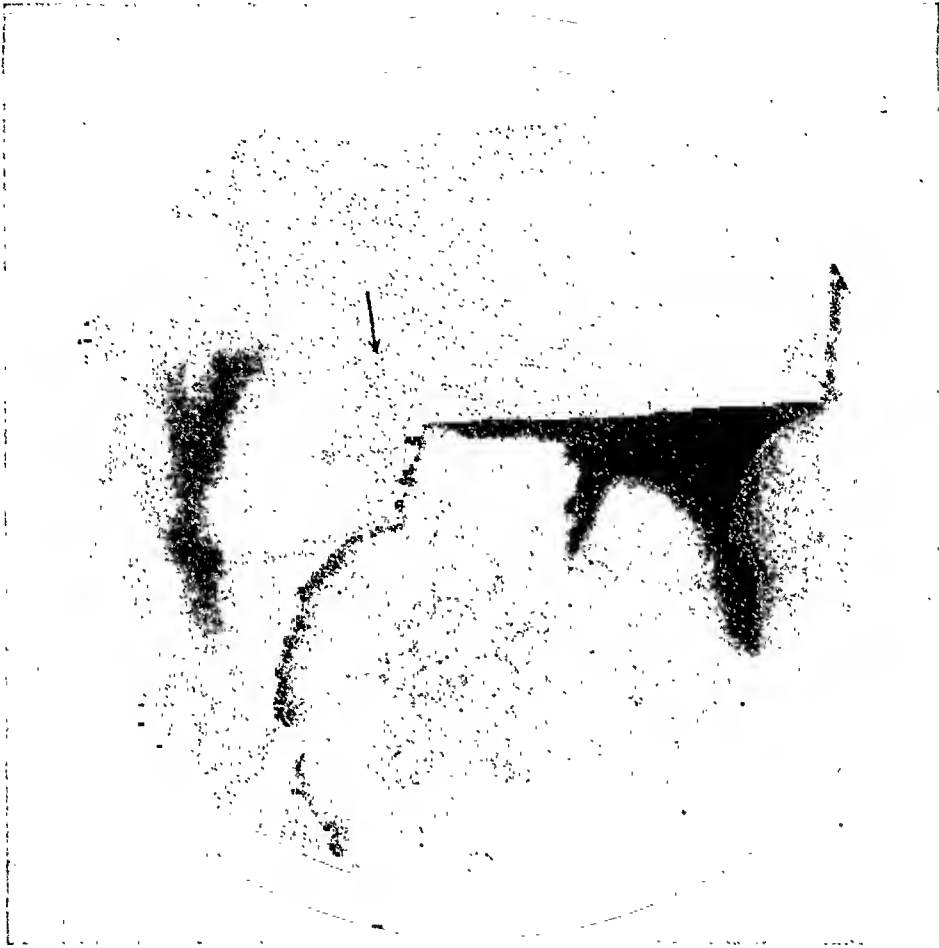*It practically never happens that a niche*

FIG. 36.

FIGS. 35, 36. Married woman, aged forty-six. Abdominal symptoms for many years. Oval-shaped en-face niche, size of a hazelnut, with deep defects from all sides (Fig. 35). After cure there only remains a niche, size of a linseed, only visible on films exposed with spiral diaphragm compressor (Fig. 36).

the mucous membrane usually surrounding the ulcer is not present in individuals who have lost a great amount of blood, as a result perhaps of the blood-letting effect on the ulcer (this question will be dealt with later on); on that account it is rendered very difficult or even impossible to

formation occurs isolated in an ulcer deformity but it is nearly always combined with one or several of the other configuration components which may take part in such an ulcer deformity and to which we will now pass on.

(To be Concluded)

CHYLOTHORAX AND CHYLOUS ASCITES*

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NEW ORLEANS, LA.

At the outset an apology must be made for the title for I realize that chylothorax and chylous ascites are manifestations and not a disease entity.

The case which forms the basis of this report presented so many interesting features that I felt that it would be worthy of a separate report. It is true that chylothorax and chylous ascites are only manifestations of an obstructive phenomena, but sufficient emphasis could not be laid on the significance of these phenomena if the case were reported in a group with other tumor cases where retroperitoneal and thoracic lymph structures are involved. This latter will be done in a subsequent presentation.

For the purpose of argument a summary of the case will be presented first and a detailed report later in the paper.

The patient in question was a woman forty-six years of age who first noticed an enlargement of the glands in her neck one year before she came under our observation. During the next twelve months the axillary, inguinal and epitrochlear glands successively became enlarged. The glands' masses were discrete and painless. The disease ran an irregular febrile course.

Because of her glandular involvement she consulted a doctor who gave her potassium iodide and neosalvarsan.

There was progressive loss of weight, digestive disturbances, orthopnea, nausea and vomiting, progressive enlargement of the abdomen and extreme weakness.

At the first examination a diagnosis of Hodgkin's disease was suggested.

The patient was admitted to Touro Infirmary for diagnostic study. The blood Wassermann test proved to be negative. Other blood examinations revealed a secondary anemia, without a leucocytosis and without a marked variation from the normal differential leucocyte count.

So far the findings seemed to eliminate lymphatic leucemia, tuberculosis and syphilis.

A biopsy was done and the report came back lymphoblastoma not characteristic of Hodgkin's disease.

As the condition progressed it was necessary to do a paracentesis and thoracentesis. The fluid removed from the chest was of a milky consistency and the analysis of this showed it to contain about 1 per cent of fat.

The finding of what seemed to be chyle in both the abdomen and the pleura increased the interest in the case. This prompted an investigation of the literature to see if I could find similar cases and if possible have some light thrown upon the etiologic factors in such a case.

Many interesting studies have been made of chylous ascites and chylothorax. It will not be necessary to review in detail all of them, but due credit should be given to the splendid review which was made by Handman, who in 1899 reviewed the literature up to that time. He was only able to collect 41 cases in the literature over a period of 260 years preceding.

Shaw, in 1900, reviewed the literature again and attempted to classify the cases which he had collected up to that time. He found that the cases immediately divided themselves into two groups, those in which the effusion was chyle and those in which the effusion was chyliform. In cases in which there was a true chylous ascites and chylothorax the conditions found were either obstructive in character or associated with external violence which had produced an injury to the thoracic duct.

In 1907 George Dock presented a case in great detail. Those interested in the subject will do well to read the original report.

In 1913 Sale reviewed the literature. In 1916 Tuley and Graves reported a case

which in all respects is identical with ours, and expressed the opinion that obstruction of the duct, and inadequate collateral circulation result in dilatation of the duct and its radicals which is followed by an escape of chlye, by transudation, into the serous cavities.

When one considers the number of retroperitoneal masses and other abdominal tumors, as well as mediastinal growths, it is surprising to note how few of these cases are associated with sufficient pressure on the thoracic duct to cause a transudation of chyle into the serous cavities.

Lediard in 1913 presented a report on cases of chyliform effusion.

Lewin after presenting his case concluded that the diagnosis could only be made with the aid of the exploring needle or by postmortem examination.

I think all of the evidence accumulated in the literature as well as this personal observation confirms the observation of Lewin.

It is easy to understand the progressive emaciation when one notes the rapid reaccumulation of chyle in the serous cavities after its removal.

From a study of the cases reported it is clear that no form of treatment so far devised can possibly overcome the obstructive phenomena. Apparently the only hope lies in the direction of some form of treatment which will cause regressive changes in the tumor masses producing the obstruction of the thoracic duct. Thus far neither radium nor x-ray has succeeded.

The changes noted in the hip joint are of interest because I have not been able to find similar changes reported in the literature. In Hodgkin's disease there are several reported cases where an osteosclerosis, myeloid in character, has been found. This and one other case which will be included in a report on retroperitoneal malignant lymphomata, are the only instances where a destructive process involving the hip joint has been found in my experience. It is mentioned here that under similar circumstances others may find it of diagnostic value.

CASE REPORT

Miss F. A., aged forty-six years. Entered Touro Infirmary June 4, 1924. Provisional

Fig. 1. Chest. Retroperitoneal and mediastinal lymphosarcoma with sarcoma of spleen.

diagnosis: Hodgkin's disease. Final diagnosis: Malignant lymphoma of retroperitoneal glands, mediastinal glands, obstruction of thoracic duct, metastatic lymphoma, spleen, liver and kidney.

Family History: Father died of cancer of stomach; Mother, senility. The family history is otherwise negative for cancer, and there is no history of tuberculosis in the family.

Personal History: There is nothing in her personal history which is pertinent to the present condition.

Present Illness: Her present illness began about June, 1923, at which time she noticed that the glands in one side of her neck began to enlarge. During August, 1923, the axilliary glands became noticeably enlarged. The cervical glands gradually increased in size until January, 1924, at which time the patient says the glands were about the size of a goose's egg; they were not painful.

During May, 1924 the inguinal glands became enlarged and just prior to her coming under our observation the epitrochlear became enlarged.

A few days ago the patient noticed a swelling under her tongue (she referred to the enlargement in the submental region). She complained very soon after the enlargement in her neck was noticed of a pain in her left hip.

The patient has recently noticed digestive disturbances, particularly a sense of fullness or

pressure in the upper abdomen which would last for two or three hours. She did not complain of eructations unless she would take

FIG. 2. X-ray of hip.

medicine. Orthopnea was a prominent manifestation after eating. The loss of weight has been rapid and progressive. When she first became ill her weight was 145 lb.; recently patient says that she has lost about 25 lb. in one week. Her present weight is between 90 and 100 lb.

The patient has had an irregular febrile reaction for some time. There has been progressive enlargement of the abdomen during the past three or four weeks. Weakness has been extreme recently.

Physical Examination: The patient shows a normal skeletal development, but she is emaciated and gives the appearance of being very ill. Her skin is warm, dry and loose, evidence of great loss of subcutaneous fat.

The pupils are equal, react equally to light and accommodation. There is no discoloration of the sclera. Her breath is foul and her teeth show marked decay.

Neck: Cervical glands enlarged. Posterior auricular and submental glands are markedly enlarged and they vary in size from about ¼

in. to 2½ to 3 in. The skin is freely movable over the glands and there is no evidence of recent inflammatory changes in the skin. Most of the glands are discrete, although some of them give evidence of some matting together. The pulsations in both sides of the neck are marked.

Chest: Chest is well developed, but markedly emaciated as the supraclavicular fossae, suprasternal notch, clavicles and ribs are very prominent. The scapulae look almost like winged scapulae. There is marked atrophy of the breasts.

There is dullness on percussion in the right and left apices, as well as in the right and left axillae. There is hyperresonance anteriorly below the clavicles. There is an absence of breath sounds below the axillary fold on both sides. Bronchial breathing posterior to the inferior angle of the scapulae. There is marked bronchovascular breathing over the right and left apices.

Heart: Soft systolic murmur in mitral area which is not transmitted. I am unable to percuss heart. The sounds are weak, rapid, but there is no irregularity.

Abdomen shows marked distention. Skin is glossy. The umbilicus is pushed out. No tumor masses are palpable. There is a shifting area of dullness and transmission of fluid noticed three fingers below the umbilicus. The spleen is palpable well below the umbilicus and it has a nodular feel.

Extremities: Edema of both feet, particularly marked on the left side.

Blood examination showed secondary anemia with a normal total white count and a differential white count which did not differ from the normal. Total white 8250. Total red, 2,925,000. Hemoglobin 45 per cent.

Wassermann test is negative.

X-ray examination of the chest, left hip and right tibia, was made. The x-ray report is as follows: "Fluoroscopic and radiographic examination of the chest shows the diaphragm high on the left side with some opacity, and a thickness of the pleura. The heart shadow is slightly pushed to the right with an enlargement of the heart to the right and left. The radiograph shows evidence of a thickened pleura on the left, with some possible effusion. The liver is enlarged upward. The fibula on the right shows some periosteal changes. *The left hip joint shows a destruction of the lower end of the hip joint which is quite extensive.*

Radiographic examination of the right hip joint shows no evidence of abnormality" (Drs. Samuel and Bowie).

specimen of the ascitic fluid was sent to the laboratory for examination, particularly for a cell count and staining of a centrifuged speci-
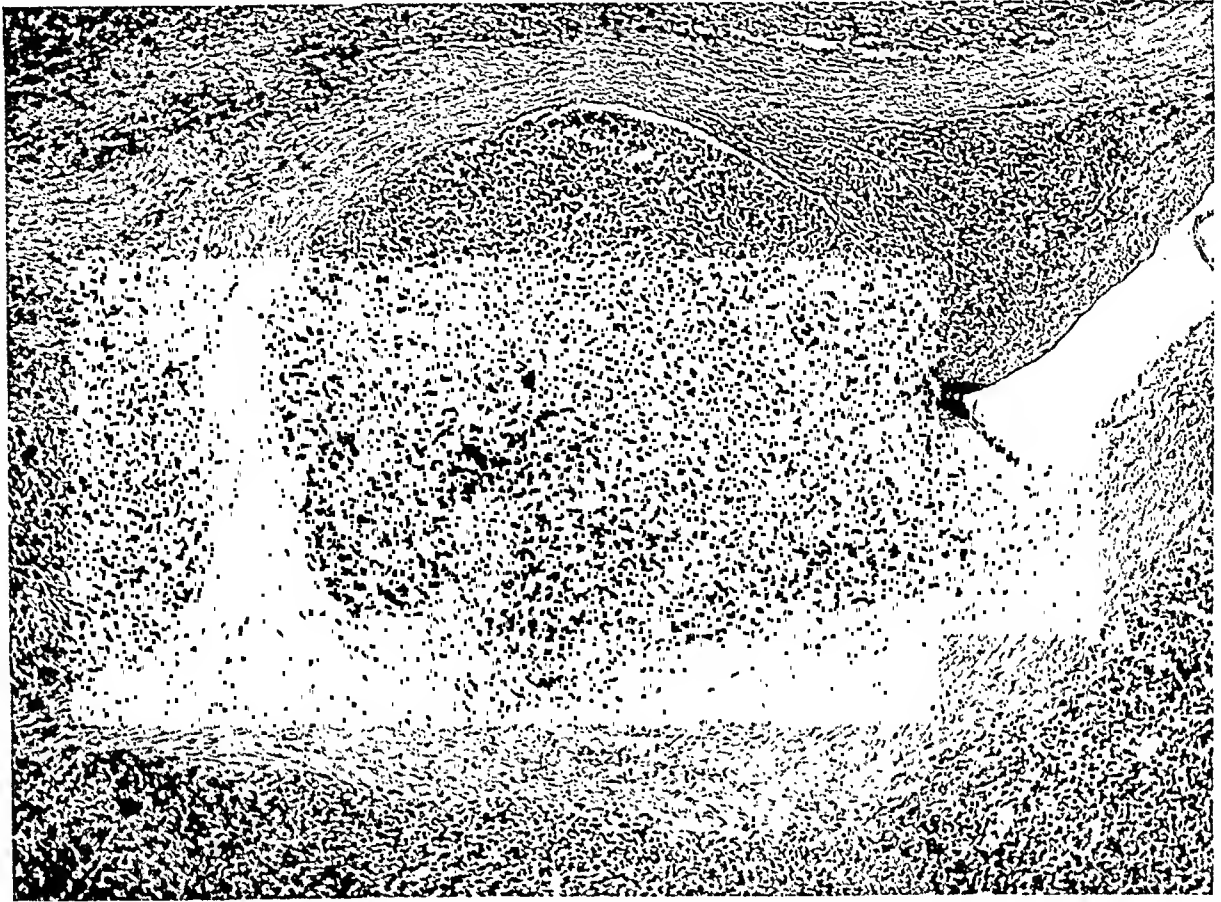

FIG. 3. Photomicrograph of section of retroperitoneal lymph node. Reported by Dr. James Ewing as lymphosarcoma.

Examination of the urine revealed specific gravity 1.029; negative for albumin, sugar, acetone. Microscopic examination revealed a few pus cells, also epithelial cells.

Under local anesthesia a biopsy was done. The laboratory findings as reported by Lanford are as follows: "Oval gland measuring about 2 cm. in its greatest diameter. Outer surface somewhat rough, pink in color, covered by a capsule. On section cut surface presents a glistening pinkish appearance. It is soft in consistency, fairly cellular in character. Diagnosis: Lymphoblastoma not characteristic of Hodgkin's disease."

Because we believed that we were dealing with Hodgkin's disease, deep x-ray therapy was started on June 5. During the past few years I have used radium in Hodgkin's disease by preference.

On June 7 paracentesis was done and we obtained about 4000 c.c. of a serous fluid. A

men. No bacteria could be found in the fluid. A differential count showed 74 per cent small lymphocytes, large mononuclear leucocytes 23, neutrophils 3.

Following the paracentesis the liver was palpable as far as the anterior superior spine of the ileum. The surface of the liver was nodular.

During the next few days the patient developed a diarrhea, but nothing unusual was noted about the stools.

There was a progressive and rapid refilling of the abdomen. Because of this fact it was decided to see whether palliation would result from a Talma type of operation and therefore the following procedure was carried out on June 18, 1924.

Local Anesthesia. Right rectus incision about 1½ to 2 in. long. When the peritoneum was opened about three-fourths of a gallon of straw colored fluid was removed. The liver

was examined and nodules were seen on the surface. With the hand in the abdomen I attempted to find some omentum. The only

On July 7, dyspnea was more marked, respiration rapid and shallow. The apex impulse was noted on the right, mesial to the nipple,
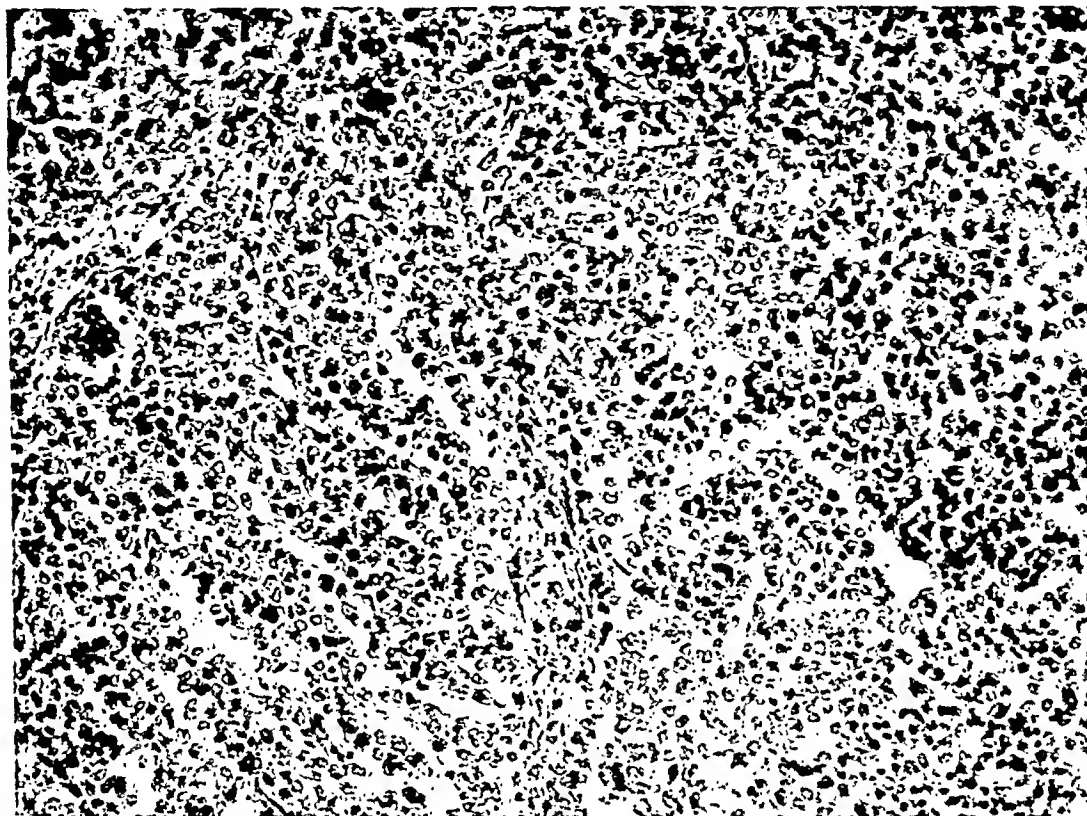

FIG. 4. High-power photomicrograph, same tissue. Lymphosarcoma.

thing which we did note by this examination was that no hollow viscera could be found; that the solid organs occupied the anterior portion of the abdominal cavity as far down as the pelvis. The liver had become adherent to the peritoneum on the right side just below the anterior, superior spine of the ileum, nature thus having formed an artificial hepatopexy. The spleen or liver (not able to say which) could be palpated on the left side as far down as the anterior superior spine of the ileum. Since we could neither see nor feel the omentum, we closed the abdomen with through and through silkworm gut sutures.

Postoperative diagnosis: Hodgkin's disease.
Pathological: Malignant lymphoma.

Patient made an uneventful recovery from the operation.

On July 7, blood count was made and two rather interesting phenomena were noted: a marked leucopenia and an increase in the total red.

about the fifth interspace. The veins in the midaxillary on the left side were about the size of a goose quill.

The mass of glands in both axillae was larger than on previous examination. Dullness on the left side of chest from the second rib to base, anteriorly and posteriorly. There was bronchial breathing above the fourth rib, anteriorly. The voice sounds were indistinct below this level. The heart sounds were distant on the left, but were easily heard on the right side at the fifth interspace. Evidently the heart was displaced to the right by fluid in the left chest.

Abdominal examination showed that it was dome shaped; there was dullness over the entire abdomen. By paracentesis we obtained about 2000 c.c. of milky fluid. This fluid looked so much like chyle that tests for fat were made by Dr. Holladay, the interne on the service. The laboratory findings were as follows: Specific gravity 1.016; albumin 45 per cent;

non-protein nitrogen 19-8 mg. per 100 c.c.; fat (Babcock) less 1 per cent; urea nitrogen, 9.9 mg. per 100 c.c.; dextrose 110 mg. per 100 c.c.; sediment, many red cells (blood) found. No abnormal increase in white cells.

On July 8, thoracentesis was done on the left side and about 1375 c.c. of milky fluid obtained. Immediately following the thoracentesis the patient felt very much better, respiration was less embarrassed.

On July 11, three days later, because of the rapid reaccumulation, thoracentesis of left side was done; 1250 c.c. was obtained.

On July 15, paracentesis was done, 2000 c.c. of milky fluid removed from the abdomen.

On July 18, 1940 c.c. of milky fluid was obtained from chest.

On July 24, 2000 c.c. of milky fluid obtained.

On July 25, the patient's dyspnea was great and the abdomen seemed full. An attempt was made to do a paracentesis, but solid viscera seemed to act as a stopper and we were unable to obtain fluid.

On July 26, there was dullness of the entire left chest. Anteriorly and posteriorly voice sounds were distant. Apex beat on right to 1 in. mesial to right nipple. Heart sounds clear, regular. Glands: the masses in both sides of the neck have increased in size. They remain movable but in a definite chain extending from tip of mastoid nearly to clavicle. The masses in the axilla have increased in size. The lymphatics of the left side of chest wall leading to axillary group are enlarged and palpable for a distance of about 4 in.

On July 28, 1975 c.c. of milky fluid were obtained from the chest.

On July 31, 1000 c.c. aspirated from the left side of the chest.

On August 6, the right side of the chest was aspirated and about 500 c.c. of milky fluid obtained. At this time edema was noted in both lumbar regions. The glands in the right side of her neck were markedly increased in size, yet there was no evidence of a degeneration. There was, however, some fusion of the mass, but it was not adherent to the skin.

The blood picture on August 10 showed total white 6250; total red 2,070,000; platelets 290,300. Hemoglobin (Dare) 25 per cent.

By this time the patient was very weak; she complained of a great sense of tightness in the abdomen after eating. There was marked edema of both upper and lower extremities. The edema of the abdominal wall was progressing.

On August 26, the left pleural cavity was aspirated; about 1200 c.c. of milky fluid obtained. The mass in the neck, axilla and inguinal regions progressively increased in size. Her dyspnea increased, weakness was progressive and the only comfortable moments which the patient had during the interval between September 1 and her death on September 3 were obtained as a result of the use of morphine. Death came suddenly on September 3 when the patient attempted to support herself in bed.

An autopsy was done shortly after death by Dr. John Lanford, Pathologist at Touro Infirmary. An abstract of the autopsy findings is appended.

Post-mortem Record: Miss F. A., by Dr. Isidore Cohn, died September 3, 1924, 1:15 P.M.

Body is that of a white female, about 5 ft. in length. General nutrition fair. The skin is tense and shiny and edematous over the entire body with exception of the anterior surface of the arms, chest and face. Scattered over the lower abdomen are small petechial hemorrhages.

Palpation of the neck shows cervical nodes to be enlarged. There is a gland about the size of a pecan in the anterior cervical group on the right side. There are two large masses the size of a pigeon's egg in the posterior group. The veins of the neck are distended.

The thorax is of the long narrow type with deep intercostal spaces and prominent ribs. The axillary glands on the left side are enlarged, varying in size from a marble to a pigeon's egg and on the right side there is one the size of a hen's egg.

Abdomen is greatly distended, walls being very edematous. There is a scar on the right side of the abdomen.

Both lower extremities are edematous. The left showing small pin-point punctures from which serum is exuding.

Upon opening the abdominal cavity the wall is found thickened due to an extreme amount of edema. The abdominal cavity contained about 3000 c.c. of cloudy fluid. The omentum extends midway between the umbilicus and the symphysis pubis.

The liver extends 2 cm. below the costal margin on the right at the mid-clavicular line and 10 cm. below the zyphoid process

num shows a number of tumor masses replacing the lymph nodes.
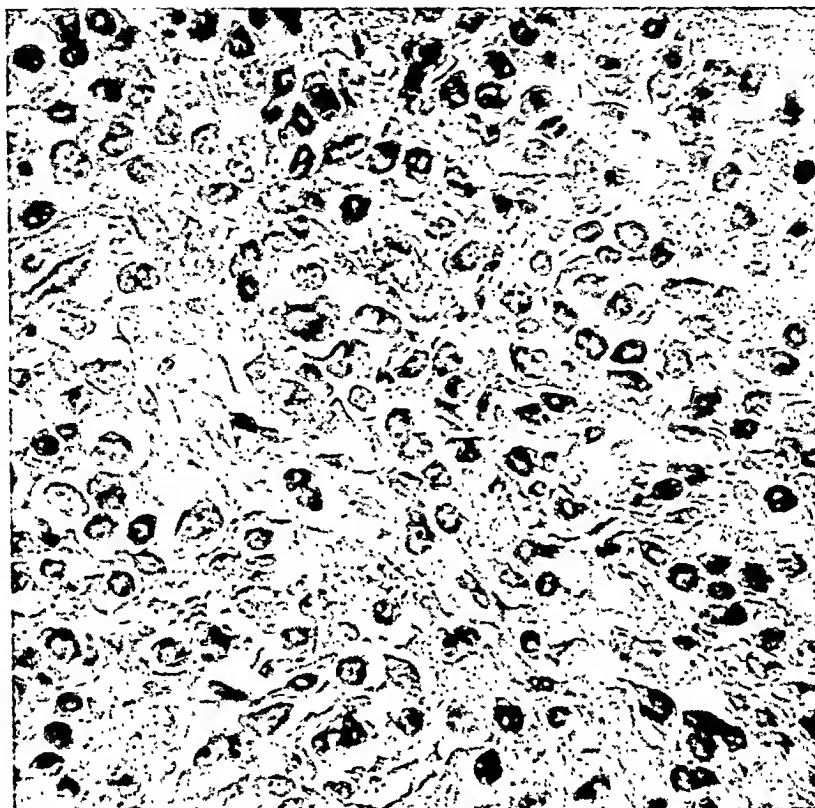
The pericardial cavity contains about

FIG. 5. Spleen from same case. Reported by Dr. John Lanford, lymphosarcoma; Dr. James Ewing, lymphosarcoma; by Dr. Clarence Cohn, lymphosarcoma, possibly Hodgkin's disease.

in the midsternal line. The spleen extends 2½ cm. below the costal border in the axillary line and in the left parasternal line. Diaphragm extends to the fifth interspace on the left side and to the fifth rib on the right side.

Pleural Cavity: On the opening the left pleural cavity is found to be filled with about 2 l. of reddish brown fluid. The left lung is completely collapsed and the parietal pleura is discolored. The right pleural cavity contains fluid similar in consistency and color but only about 500 c.c. The lung on this side is apparently normal in position and shape. There are a few nodules on the pleural surface of the diaphragm in the area of the midline. These nodules vary in size from a peat to a walnut. The first portion of the mediasti-

100 c.c. of straw colored (clear) fluid. The heart is displaced to the right, the apex being 1 in. to the left of the midline, the right side being dilated and the left contracted. Upon incising the heart, the outer surface is found to be pinkish brown in color, the epicardium is slightly edematous and the outline of the vessels prominent. The heart muscle is flabby and shows an increased amount of connective tissue running in distinct white cords through the brown muscle. The endocardium is free from acute or chronic inflammatory reaction. The valves are normal. The attached portion of the aorta shows a few early atheromatous placques.

Lungs: Upon removing the lungs the left one is found to be almost completely collapsed and uniform in consistency

throughout except the apices are slightly emphysematous. The right lung is crepitant with a few edematous areas but no evidence of new growth or pneumonia is found.

Liver: The liver is 20 cm. × 19 × 7 in dimension. The outer surface is rough, irregular, covered with recently organized adhesions. In addition there are a few elevations corresponding to the seat of newgrowths. These changes are mostly confined to the right lobe. The under surface presents a similar picture except that the exudate is more recent.

Spleen: The spleen measures 10 × 5 × 1 inches and is firm and uniform in consistency. The outer surface shows many adhesions. The color is mottled, varying from a dirty cream to purple. Upon sectioning it is found to offer increased resistance to the knife. The cut surface shows the normal tissue to be largely replaced by newgrowth and appears somewhat like a cross section of a bologna sausage, there being areas, light cream in color, irregular in outline, which are surrounded by deeply red zones of splenic pulp. The material does not easily scrape off with the knife.

Kidneys: The left kidney is smaller than normal. The right kidney is increased in size, firmer than the left and upon peeling back the capsule the outer surface is slightly granular and firm and pinkish nodules of a secondary growth are found.

The adrenals are free from evidence of new growth.

Retroperitoneal Lymph Nodes: The retroperitoneal lymph nodes are enlarged and matted together and upon following up the thoracic duct we find enlarged structures resembling tumor masses at intervals along its entire course which are pressing upon it, preventing free flow of fluid.

Pelvic Organs: The broad ligaments are filled with firm hard nodules, varying in size from a small pea to a pecan, which are secondary growths. The tubes present similar nodules. The uterus is also nodular, presenting secondary growths on its serous surface. The right and left ovaries are infiltrated with secondary growths.

Anatomical Diagnosis: Lymphosarcoma, primarily in the retroperitoneal lymph nodes with secondary metastasis to the lymph adenomatous structures of the entire body.

Secondary lymphosarcoma of the kidney.

Obstructed thoracic duct. Peritoneal chylous transudate. Pleural chylous transudate. Atelectasis of the left lung. General anasarca. Chronic nephritis, chronic proliferative peritonitis, Lymphosarcoma of spleen. (Lanford).

Specimens of the mediastinal gland and the spleen were submitted to Drs. James Ewing and Joseph Bloodgood. The following reports have been received.

Dr. Ewing reported:

The case of retroperitoneal lymph nodes seems to me to fall in the group of lymphosarcoma. Definite features of Hodgkin's disease are not present, but as you know, in some cases of Hodgkin's, the process resembles sarcoma. This is probably one of those cases.

In the section of spleen, I think the process is so cellular that it must be regarded as a splenic sarcoma arising from the reticulum cells of the follicles. Yet, Dr. Stewart, my colleague, thinks this is a case of Hodgkin's disease. I do not find the features of Hodgkin's disease, but again this may be Hodgkin's disease of sarcomatous type.

I think this is a case of lymphosarcoma. Whether it arises on the basis of Hodgkin's disease, as Dr. Stewart thinks, I am unable to state, but I do not find any definite lesions of Hodgkin's disease.

The following report was received from Dr. L. Clarence Cohn, associate of Dr. Bloodgood who kindly examined the specimen for me in Dr. Bloodgood's absence:

The section from the gland shows a lymph gland in which there is no germinal center. The gland is very cellular and there is a great deal less stroma than we usually see in Hodgkin's disease. It is more like the gland of lymphosarcoma. Nevertheless there are so many large cells with multiple nuclei suggesting Dorothy Reed cells that I would be more inclined to think of Hodgkin's disease than lymphosarcoma. Section from the spleen shows pretty much the same picture except perhaps

there is a little more stroma and not so many of the large multinucleated cells. Nevertheless they are present.

SUMMARY

1. This patient presented progressive involvement of all of the superficial lymph nodes.

2. Obstructive phenomena were present. About 12,000 c.c. of chylous fluid were removed from the chest at various times.

3. At autopsy we found enlarged mediastinal lymph nodes which obstructed the thoracic duct. The spleen was markedly enlarged and presented the appearance of a cross section of a Bologna sausage.

4. The clinical syndrome was confused with Hodgkin's disease.

5. The difficulties in diagnosis are evidenced by the differences in opinion expressed by the pathologists who have examined the specimens.

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* Continued from p. 232.

HISTOLOGIC STUDIES OF THE THYROID GLAND. I.*

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SINCE the question frequently arises as to what constitutes normal and abnormal thyroid tissue, we have obtained for study sections from people whose deaths were due to accidental causes. These patients vary in age from still-births to eighty-nine years. As a means of comparison there are also sections from people who died from acute and chronic diseases. This work began in April, 1929, and through the courtesy of Dr. Charles Norris, Chief Medical Examiner of New York; Dr. Douglas Symmers, Director of Laboratories, Bellevue Hospital, and the House Staff of the Fourth Surgical Division, we were able to obtain the material.

On January 1, 1930 we had studied sections from 107 cases. It has been our intention to get sections on a large series of cases, rather than serial sections on a few cases, as these would represent more nearly the pathological reports that are received from operative specimens. So far there have been 80 cases of accidental death from which sections of the thyroid have been studied. There are also 27 cases of patients who died from some systemic disease and it was thought best to divide them into two groups. 1. Acute diseases, any case of a patient dying in less than three weeks from the onset of the disease. 2. Chronic diseases, those extending over months or years. There was 16 deaths due to acute diseases but the sections in this group failed to reveal any definite histological changes. There were 2 patients who died from chronic diseases and we have been unable to find any striking changes produced in the thyroid in this group.

To have a working basis for normal thyroid tissue Figure 1 is a reproduction from Piersol's[1] histology which represents the acini of a relatively uniform size and containing colloid. There is also connective tissue dividing the gland into lobules, as well as interacinal connective tissue. In a recent editorial[2] the author states, "The normal gland contains a relatively large proportion of small follicles, but these contain colloid. Undifferentiated follicles or interfollicular cell groups like those described by Wolfert were not observed in serial sections of either the normal or hyperplastic organ." The picture presented by Piersol and the opinion expressed in the recent editorial seem to coincide.

This work has been divided into 6 groups. Group 1. Still-births. Group 2. Infants from birth to two years. Group 3. Children from two to twelve years. Group 4. Adolescents from twelve to eighteen years. Group 5. Adults from eighteen to sixty years. Group 6. Beginning senility, from sixty years up.

GROUP 1. In the study of the 9 cases in this group the microscopical sections revealed the gland divided into lobules with the epithelial cells closely spaced and interstitial tissue absent. Occasionally there could be seen a developing acinus but without colloid material. Figure 2, female, still-birth, due to cranial injuries, reveals the gland divided into lobules by connective tissue. The lobules present an occasional developing acinus but are made up chiefly of closely spaced epithelial cells. Figure 3, male, still-birth due to breech extraction, reveals similar findings to those in the former section. Figure 4, male, still-birth, due to cranial injuries, presents a picture similar to these sections. All the sections of this group present a uniform picture, as illustrated.

GROUP 2. There were 8 cases in this group but the sections did not present uniform pictures. Figure 5, male, two days,

[1] PIERSOL, G. A. Normal Histology. Ed. 10, Phila., Lippincott, 1927.

[2] Editorial. Structure of the thyroid gland. *J. A. M. A.* 94: No. 8, 1930.

died from congenital anomaly of heart. This section presents some developing acini but it contains chiefly undiffer-

FIG. 1. Acini of relatively uniform size and containing colloid. (From Piersol's Histology.)
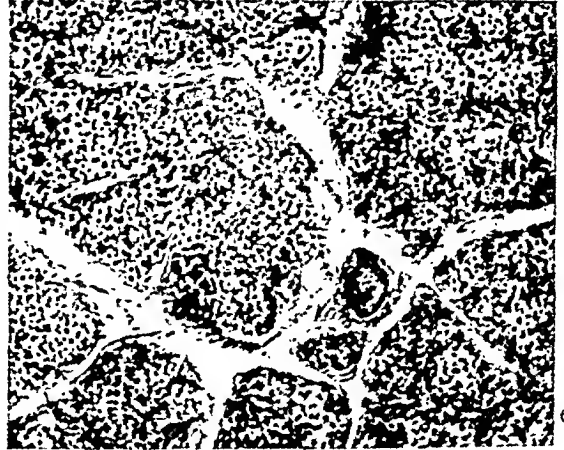
entiated epithelial cells similar to the fetal group. Figure 6, female, eight weeks, died from pneumonia. This section shows numerous formed acini containing colloid

nounced. This does not coincide with Hertzler's[1] view as he states "The amount of connective tissue of the septa varies

FIG. 2. Female, still-birth, due to cranial injuries.

according to the age of the individual, there being a marked increase in advanced years of life. This is particularly noticeable in individuals past fifty years of age when the acinal cells tend to decrease in size." Figure 7, female, four months, cause of death, dehydration. This is quite similar
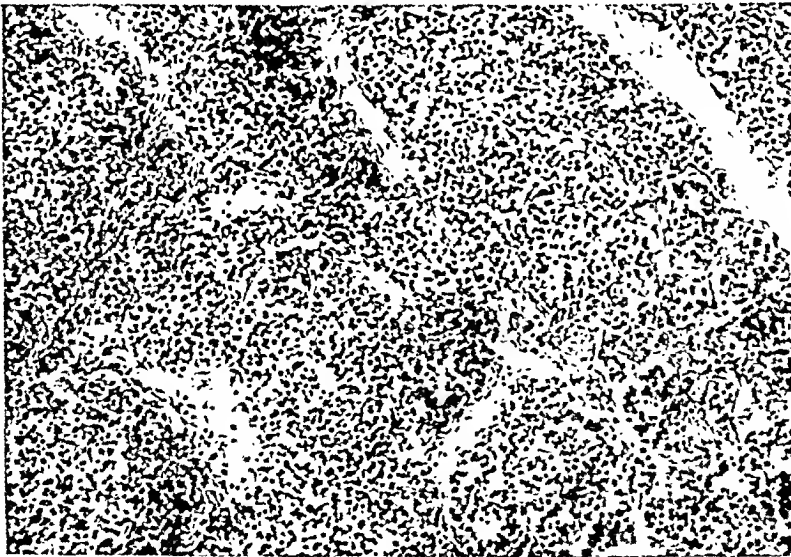

FIG. 3.

and other areas with undifferentiated epithelial cells. The connective tissue divides the gland into lobules and the interacinal connective tissue is very pro-

to the sections in the fetal group, representing chiefly masses of undifferentiated

[1] HERTZLER, A. E., Diseases of the Thyroid Gland. Ed. 2, St. Louis, Mosby, 1929, pp. 27, 29, 33, 34, 39.
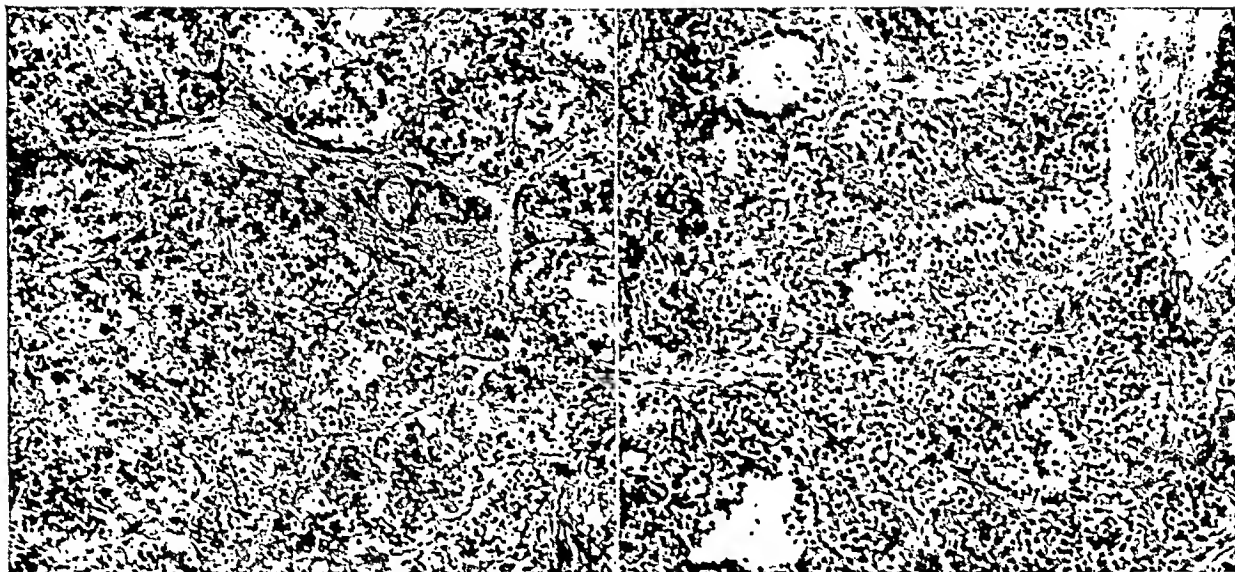
FIG. 4.

FIGS. 3 and 4. Male, still-birth, due to breech extraction.

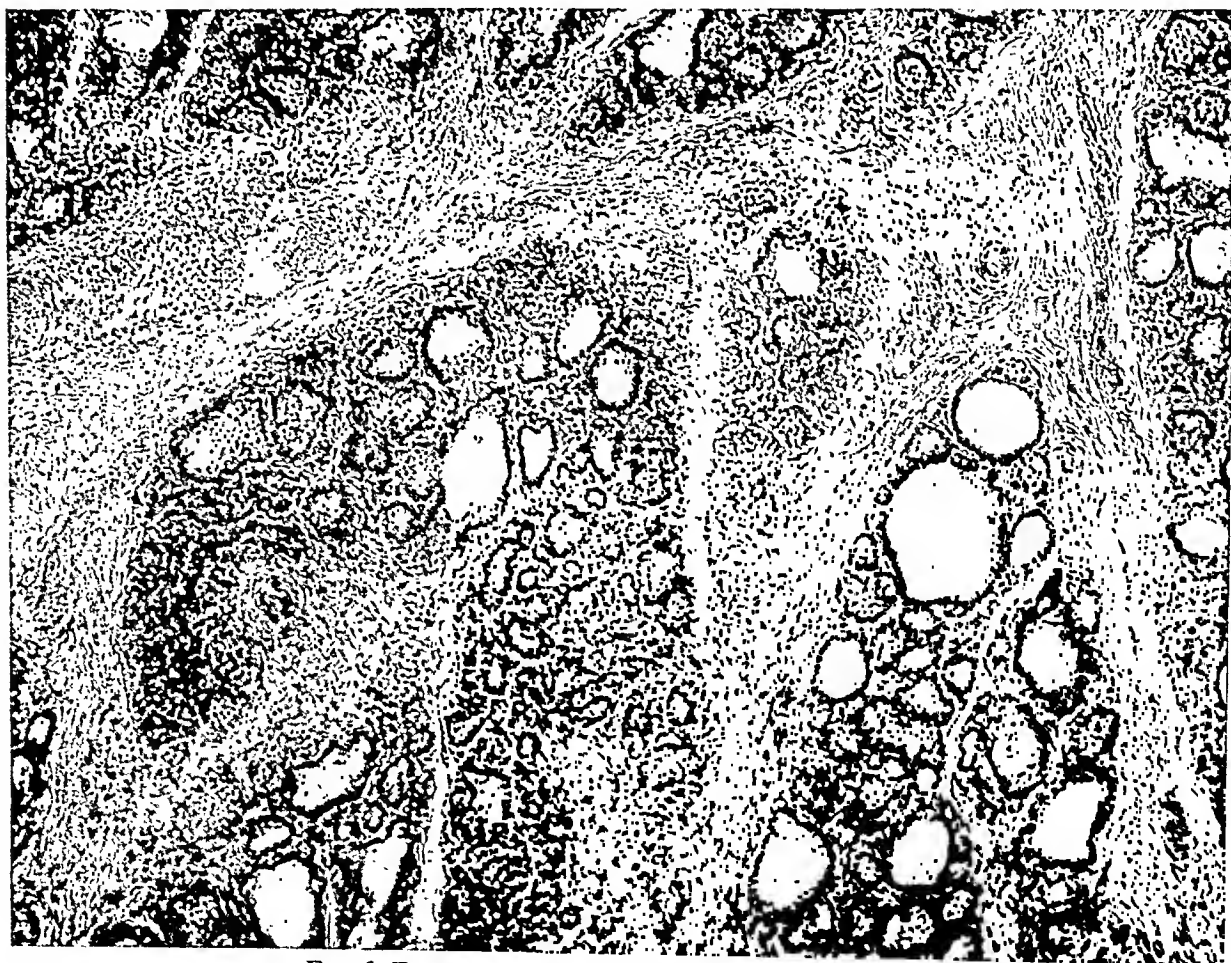FIG. 5. Male, two days old, died from congenital anomaly of heart.

FIG. 6. Female, eight weeks old, died from pneumonia.

epithelium. Figure 8, male, ten weeks, died from pneumonia. This again reveals well developed acini which contain colloid with

thirteen years, died from a fractured skull. There were well developed acini distended with colloid and a few areas of undifferen-
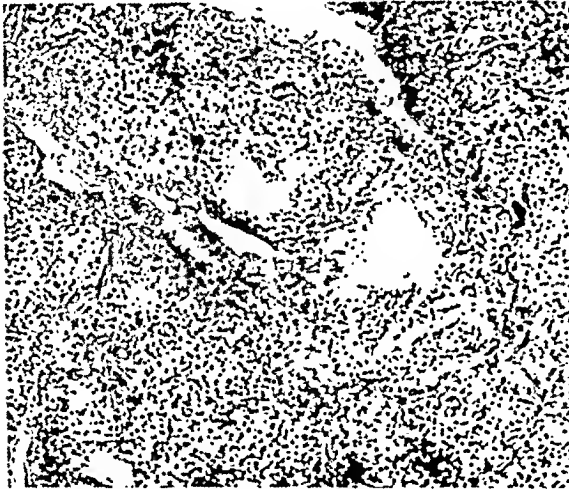

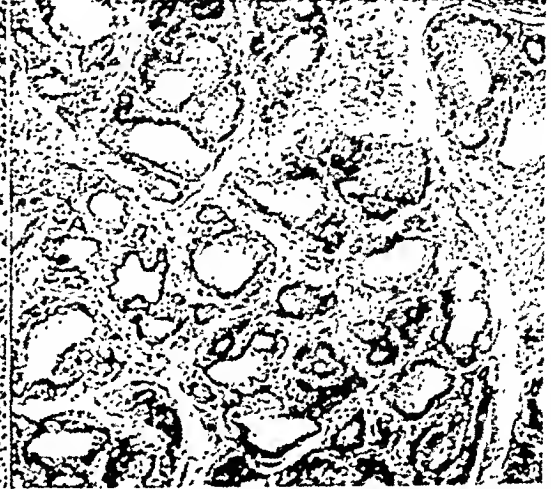FIG. 7. Female, four months old, cause of death dehydration.

FIG. 8. Male, ten weeks old, died from pneumonia.

interacinal connective tissue, even more pronounced than in Figure 6.

GROUP 3.   The sections of the 12 cases in this group revealed marked variation. Figure 9, female, three, died from tetany. This section is very characteristic of the fetal group with only occasional developed acinus. Figure 10, male, five, died from a ruptured spleen. This section revealed a few formed acini but made up chiefly of closely spaced epithelial cells. Figure 11, male, five years, died from a fractured skull. This revealed connective tissue dividing the gland into lobules with numerous epithelial cells and developing acini. Figure 12, male, six years, died during ether anesthesia for an adenoid and tonsil operation. There were several well developed acini containing colloid with some undifferentiated epithelial cells. The interlobular and interacinal connective tissue is very pronounced. Figure 13, male, six years, died from a fractured skull. There were some formed and developing acini but made up chiefly of undeveloped epithelium quite characteristic of the fetal type.

GROUP 4.   There were only 7 sections falling in this group. Figure 14, male,

tiated epithelium. Some acini contained vacuoles. Figure 15, male, twelve years, died from acute articular rheumatism with decompensated heart. There were numerous well developed acini distended with

FIG. 9. Female, three (years (?) old), died from tetany.

colloid, and a moderate amount of interstitial tissue in this section.

GROUP 5.   In this group it would seem that we should have some uniformity in the histological picture. There were 60 cases falling in this group and the sections represented practically all stages in the

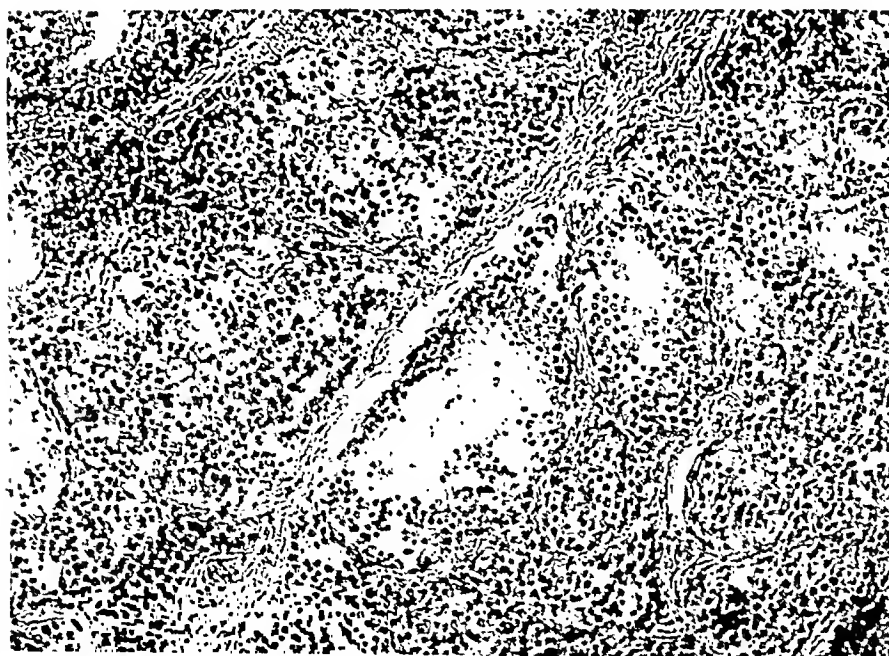FIG. 10. Male, five, died from ruptured spleen.

FIG. 11. Male, five years old, died from fractured skull.

FIG. 12. Male, six years old, died during ether anesthesia for adenoid and tonsil operation.

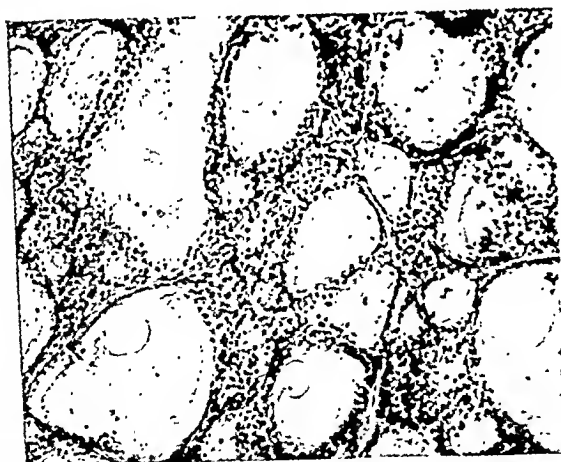FIG. 13. Male, six years, died from fractured skull.

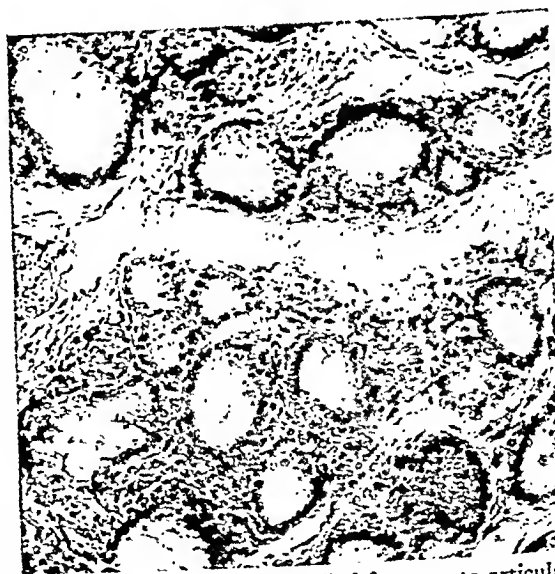FIG. 14. Male, thirteen years, died from fractured skull.

FIG. 15. Male, twelve years, died from acute articular rheumatism with decompensated heart.

growth and development of the thyroid from the fetal type in some instances to sections containing large dilated acini

numerous small acini without colloid and no connective tissue. Figure 21, male, forty-five, lobar pneumonia. There are
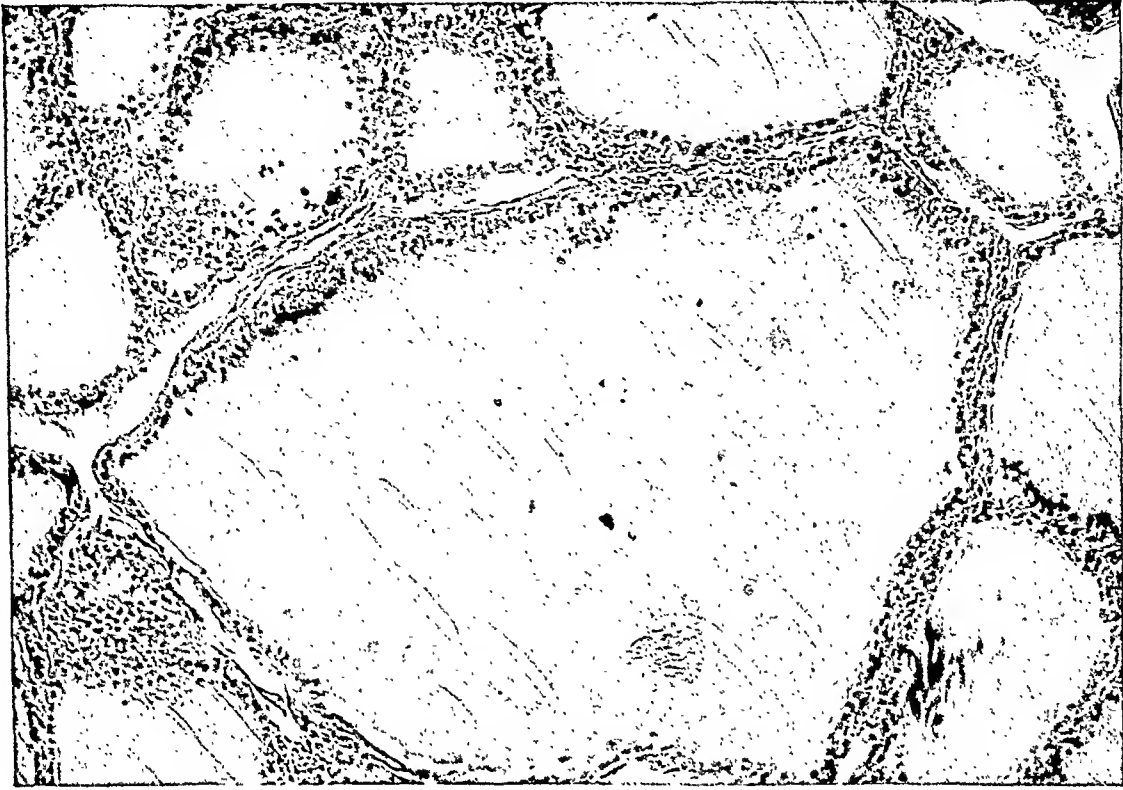

Fig. 16. Male, twenty-five years, shot by police and instantly killed.

distended with colloid and lined by flat epithelium in others. Figure 16, male, twenty-five years, shot by police and instantly killed. Note the large distended acini full of colloid with very little interacinal connective tissue. Figure 17, female, thirty-five, died from a fractured skull. This section is quite characteristic of the fetal group with some small developing acini with a mass of undifferentiated epithelium and interlobular connective tissue. Figure 18, female, fifty-six, fractured skull. There are some well developed acini in this section and numerous undifferentiated epithelial cells. Note the absence of connective tissue. Figure 19, male, sixty years, fractured skull. Acini are well developed containing colloid with considerable interacinal connective tissue. Figure 20, male, twenty-six years, died under ether anesthesia. Diagnosis, status lymphaticus. This section might be considered a diseased thyroid but it contains

some well formed acini but the section is made up chiefly of undifferentiated epithelial cells, with interlobular connective
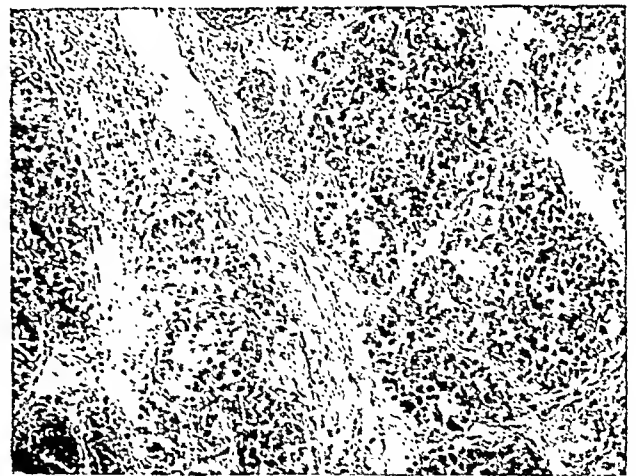

Fig. 17. Female, aged thirty-five, died from fractured skull.

tissue. Figure 22, male, forty-eight years, lobar pneumonia. There are a few developed acini in this section, and there are other smaller acini with masses of undiffer-
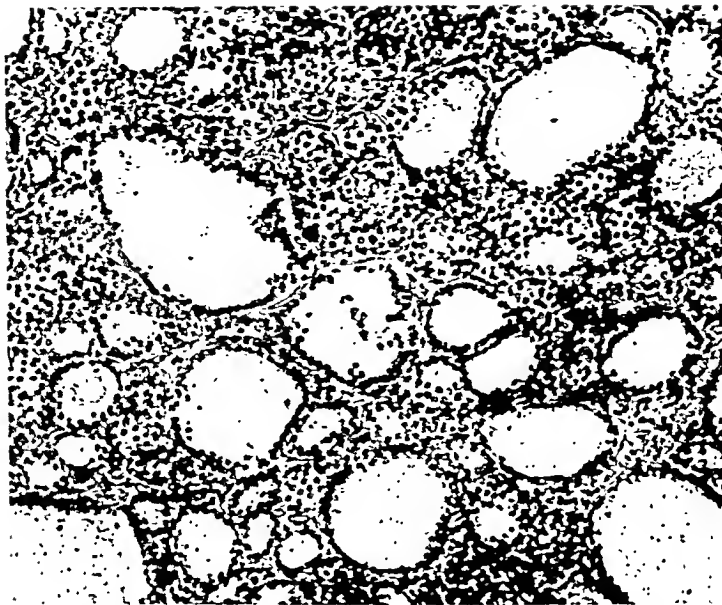
Fig. 18. Female, aged fifty-six, fractured skull.

Fig. 19. Male, sixty years, fractured skull.

Fig. 20. Male, twenty-six years, died under ether anesthesia.

entiated epithelial cells. There is very little connective tissue. Figure 23, male, twenty-five years, died from tuberculous

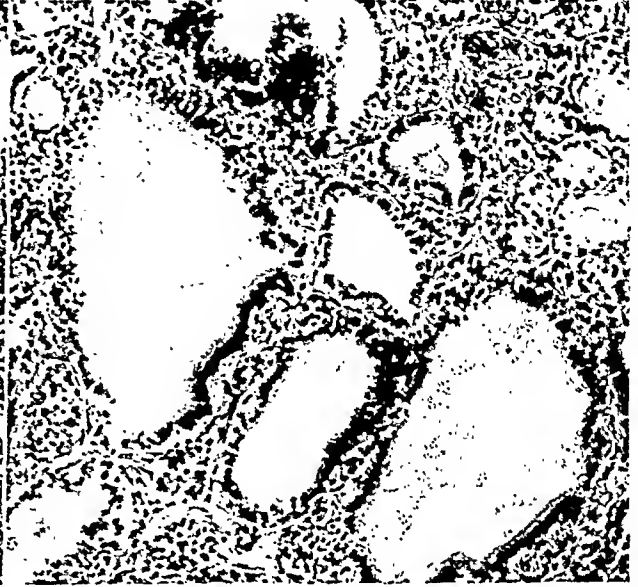Fig. 21. Male, aged forty-five, lobar pneumonia.

Fig. 22. Male, forty-eight years, lobar pneumonia.

peritonitis. This is quite similar to the fetal type with only occasional developing acinus.

Group 6. There were only 2 cases in this group and the histological picture is quite variable. Hertzler states that the "Acini in infants and children are smaller than in adults. The epithelium is taller in young subjects and the acini contain little or no colloid." Figure 24, male, seventy-five, died from a fractured skull and lacerated brain. There are some well formed acini and several smaller acini with other areas of undifferentiated epithelial cells. Note the connective tissue at the periphery dividing the gland into lobules. Figure 25, female, sixty-one, committed suicide by strangulation. This section is made up chiefly of undifferentiated epithelium with some small developing acini. There is very little connective tissue seen. Figure 26, female, eighty-three, ruptured appendix with abscess. There are 2 rather large acini containing colloid but the section is made up chiefly of very small acini and undifferentiated epithelium. There is practically no interacinal connective tissue.

It was stated in the beginning of this

paper that sections were taken from people of various ages and a rather large group has been studied with the hope of finding a uniform histological picture for normal people of different ages. So far we have been unable to draw conclusions as to what is normal thyroid tissue for the different ages and must disagree with Hertzler[1] when he states "For practical purposes I am convinced that if one keeps in mind the various changes normal to the different periods of life as above indicated, the histology of the thyroid gland will be found to be fairly constant, rendering it unnecessary to assume that it undergoes changes unknown in other organs."

COMMENT

In studying patients with thyroid diseases one is at times unable to place the case in one of the groups given for the classification of goiter, such as adolescent, adenomatous or exophthalmic goiter, and we frequently see cases change from one type to another while under observation. From this histological study it would also seem that a diagnosis made purely on the histological picture without taking into consideration the clinical history and

[1] Hertzler, A. E., Diseases of the Thyroid Gland. Ed. 2, St. Louis, Mosby, 1929, pp. 27, 29, 33, 34, 39.
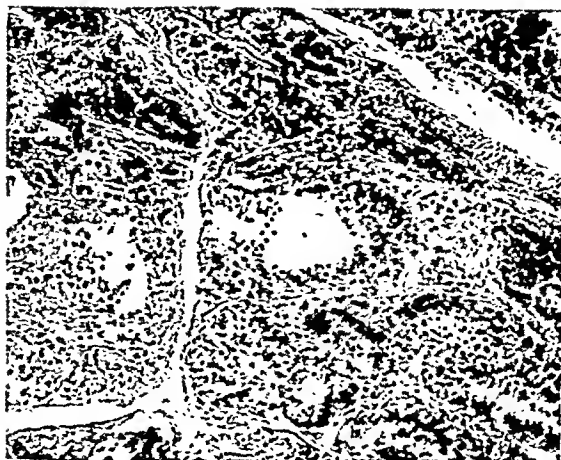
FIG. 23. Male, twenty-five years, died from tuberculous peritonitis.
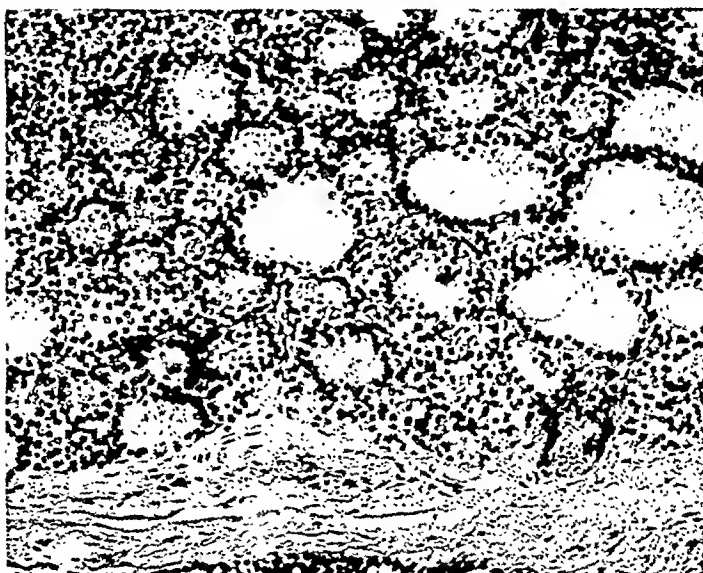
FIG. 24. Male, aged seventy-five, died from fractured skull and lacerated brain.
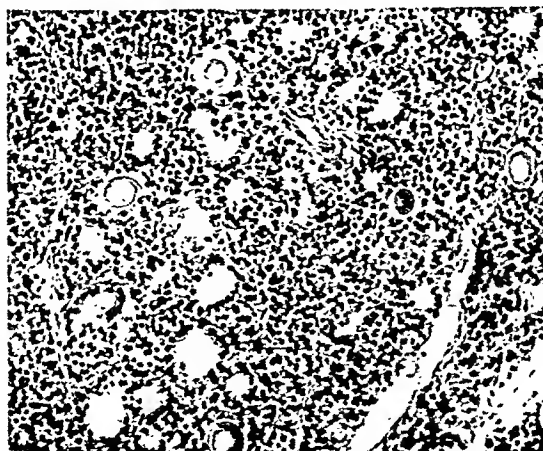
FIG. 25. Female, aged sixty-one, committed suicide by strangulation.

laboratory date is also open to error. It therefore seems that we will be forced to consider the different types of goiter merely as a stage of a continuous disease and not a definite clinical entity, as we have been led to believe in the past.
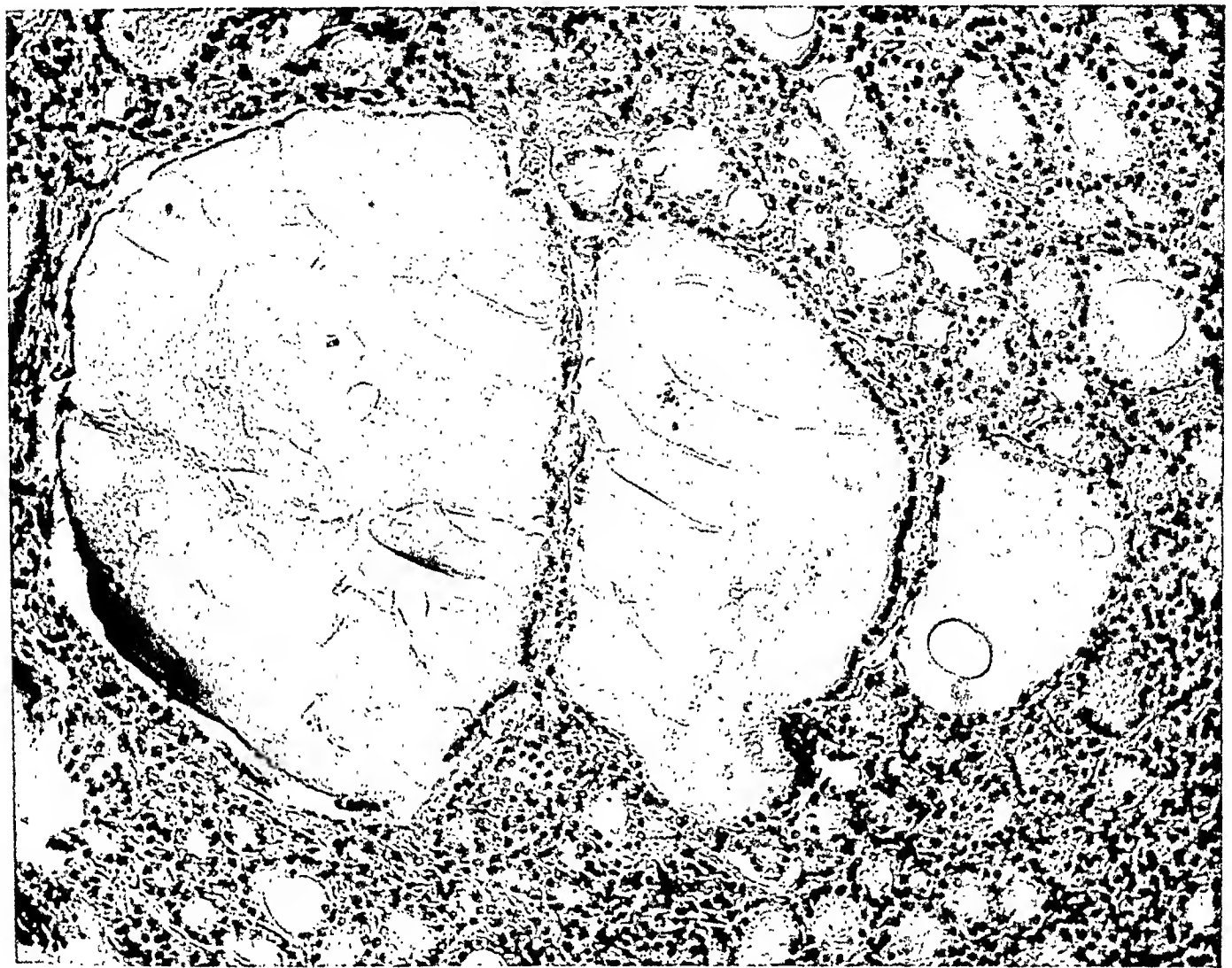
Fig. 26. Female, aged eighty-three, ruptured appendix with abscess.

GASTRIC ACIDITY IN RELATION TO BILIARY TRACT DISEASE

A REPORT OF 100 CASES*

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THE consideration of abnormal figures for gastric acidity as of diagnostic value in diseases of the biliary tract was stimulated by the evidence that accumulated during the separate experience of each of us in the medical and surgical care of patients with upper abdominal complaints. Over the same period came the discovery that save in the achylias, there was a definite tendency to a return to a normal gastric acidity when the symptoms and clinical signs of biliary tract disorders disappeared, following non-surgical bile drainages, operation or both.

The underlying factors joining the derangement of gastric secretion to biliary tract secretion naturally aroused our curiosity and the literature soon showed us that it was a well-known and almost discarded subject. It is only trite to remark here that gastric secretory derangement may be effected through hematogenous toxins; parenchymal changes in the gastric mucosa; nervous, humoral and food factors acting on the secretory glands of the stomach and upon the duodenal mucosa, with alteration of the gastric and intestinal phase of gastric digestion; finally through a derangement of the gastric motor mechanism, linked up with dysfunction of the gall bladder and Oddi's sphincter, to cause an alkaline duodenal regurgitation with a decrease or loss of free hydrochloric acid in gastric contents. Some authors seemed blind to every mechanism save the last one.

Accepting these mechanisms as operative in the type of disorders presented here, there is another factor, that is just beginning to be recognized by the physiologists, that should be brought to the attention of the clinician, namely the glyco-gen-insulin mechanism, acting through the so-called humoroneural system of Okada and his associates.[1] This system is independent of the humoral (secretin) mechanism, but is correlated with it, and directly affects the secretory function not only of the stomach but of the pancreas and liver as well. Carlson and his co-workers[2] are confirming this fundamental mechanism as affecting gastric and intestinal motility.

Therefore the one point we wish to emphasize is the fact that there is such a direct relation between fluctuations of gastric, pancreatic and biliary secretion, and changes in the glycogen-insulin ratios in the blood; that a true understanding of the humoroneural system gives us a physiological and pharmacological basis for the correlation of disorders of the liver, pancreas and stomach, so that any infection or toxin that injures one, injures the other two; that the portal system is the chief avenue for conveying these toxins, and that the liver is the organ most affected of the three; finally, that the stomach does give an early warning of dysfunction of the liver, an organ whose margin of safety permits of much destruction before serious symptoms are produced. The stomach is just as surely involved in disorders of the gall bladder and connecting bile channels. We wish to summarize Okada's findings and merely outline the latest theories relative to carbohydrate metabolism. The writers are of the opinion that a derangement of the glycogen-insulin mechanism is brought about primarily by disorders of the biliary tract, and that this mechanism acting through the humoro-neural system of Okada directly affects

gastric secretion and motility. When proof of the operation of this mechanism can be confirmed by us and others it will more readily explain our findings, namely: a tendency to a return to normal gastric acidity following medical and surgical cure of diseases of the biliary tract.

CARBOHYDRATE METABOLISM

Okada and his associates in their study, in 1929, of the humoral regulation of the gastric, pancreatic and bilary secretions definitely showed that the increased secretion of these juices after the injection of insulin is marked in the presence of hypoglycemia, while it is nearly negative in the absence of hypoglycemia. In other words, hypoglycemia, if it does not alone stimulate the secretion of these juices, does so when insulin is injected. The decrease in the secretion of these juices after the injection of epinephrine goes parallel with hyperglycemia, and is followed by an increase of secretion when a reactive hypoglycemia occurs. Hypoglycemia exerts its stimulating effect at the centrum of the secretory nerve; the stimulus is transmitted to the active tissue cells through the parasympathetic or vagal system. Hyperglycemia inhibits the centrum of the secretory nerve, with impulses transmitted probably through the sympathetic system. This glycogen-insulin regulatory function to the secretory centrum is called by Okada the humeroneural regulation of the digestive juices. In achylia and cancer of the stomach the humoroneural mechanism with the cooperation of the secretin mechanism excites to activity the secretory glands only of the liver and pancreas.

Following a test breakfast at the stage of hyperglycemia, but without injection of insulin or secretin, there was produced either no secretion of acid or a markedly diminished secretion with hypomotility; at the stage of hypoglycemia, the test breakfast gave a normal gastric secretory response with normal motility. During hyperglycemia the subjective sensation was one of fullness; with hypoglycemia, a hunger feeling. In diabetes the same humoroneural regulation of the secretory centrum is in force, being different from that in normal cases only in the threshold for entrance of the impulses.

The humoroneural and the humoral (secretin) mechanism normally cooperate without interference one with the other; an intravenous injection of secretin causing nearly as abundant a secretion of pancreatic juice at the stage of hyperglycemia as at the time of fasting hypoglycemia. When hyperglycemia develops, gastric secretion ceases and the entrance of acid chyme into the duodenum also ceases, so that the secretin mechanism does not have any occasion to function during this period. Finally a reactive hypoglycemia sets in to cause a profuse secretion of gastric juice and an abundant gush of acid chyme into the duodenum, with a distinct increase of pancreatic function, following the full activity of the secretin mechanism.

Histamine, a vigorous excitant of the gastric secretion humorally causes also a profuse secretion of gastric juice at the high point of hyperglycemia, the directly opposite action of insulin. Therefore it follows that the humoroneural regulation does not have any remarkable influence on the humoral (secretin or histamine) mechanism and this in turn proves that the action of histamine does not have anything to do with the humoroneural mechanism.

Carlson, referred to previously, writes:

One of my associates, Dr. Quigley has found that the gastric hypermotility in insulin hypoglycemia, already known, also occurs in the intestine. He has made the important observation that this hypermotility does not occur if the gastric vagi are severed. In other words this insulin hypermotility of the stomach is due to the hypoglycemia acting on the motor centrum in the medulla.

Richter[3] in his latest work on "The Newer Aspects of Liver Disorders," concludes:

The study of the abnormal carbohydrate metabolism of the liver has thrown new light

on the parenchymatous disorders of that organ. A knowledge of the bond that unites the vast number of the well known partial functions of the liver is still lacking. There is scarcely another organ in which regenerative and degenertive processes take place in such close proximity. Clinically the liver is especially important for supplying the organ with carbohydrates, lack of which injures not only the organism but the liver itself, suffering an autolytic breakdown. The glycogen constitutes thus the protection against the complete breakdown of the liver activity. It increases the capacity and vitality of the liver cell. In infections the attack on the glycogen supply is an early symptom. The liver with even a slightly damaged parenchyma has not the glycogen supply of the healthy liver. There is therefore an absolutely certain causal connection between liver injury and glycogen impoverishment. The cell that is robbed of its glycogen is disturbed in its functioning. Associated with glycogen impoverishment the tolerance for galactose is reduced; the tolerance rises with the increase of the glycogen supply of the liver. Impairment and improvement of the liver function are thus closely connected with the synthesis and decomposition of glycogen. The synthesis of glycogen and its fixation in the liver must be brought about through the administration of insulin plus the ingestion of glucose. Viewed pathogenically there is a straight line leading from the simple parenchymatous icterus to the grave breakdown of the liver; it is only a matter of gradual difference.

In the latest investigations of Depisch and Hasenöhrl,[4] the authors arrive at these conclusions:

The assimilatory insulin system with its nervous regulation stands in the center of the carbohydrate metabolism. It promotes the absorption of sugar both in the liver and in the tissues. In the liver, this system is counteracted by the sympathetic system and the secretion of the suprarenals, of the posterior lobe of the hypophysis and of the thyroid (liver counterregulation). In the tissues the effect of the insulin is counteracted by the suprarenals and the thyroid (tissue counterregulation). Independent of this hormonal regulation there appears to be also a direct influence of the nervous system on the sugar metabolism in the liver and in the tissues, both promoting and checking it.

If the work of Simpson and Macleod,[5] and of Choi[6] can be accepted, the liver glycogen is the only source of the blood sugar, since muscle glycogen is converted after mobilization into lactic acid and the latter must then be synthesized into liver glycogen before it can supply the blood with sugar.

Forsgren[7] has recently published an interesting observation on glycogen storage in the liver. While studying the relationship between the formation of bile and glycogen in the liver of the rabbit, he found that a cycle existed in the normal animal during which the percentage of glycogen and bile varied inversely to each other. Thus the glycogen was low when the bile was greatest in amount, and vice versa. He also found that glycogen is first deposited around the central vein of the lobule and remains there longest. If a condition exists in the jaundiced animal or patient similar to that found by him in the normal animal, one can see why obstruction of the duct leads to a decreasing glycogen content of the liver. Even without this explanation it is only necessary to examine microscopically sections of the liver from patients suffering from obstruction of the common duct to realize that such a liver is not capable of functioning normally as a glycogen storehouse.

Mills[8] in 1927 showed that vitamine B possesses the power of stimulating the utilization of glucose in the body with certain plant extracts by mouth, and suggests that vitamine B affords the injured pancreas an opportunity of functional recovery. It has been known for some time that pigeons on a vitamine B-free diet have a hyperglycemia and an absence of liver glycogen. His extract does not produce hypoglycemia like yeast extract, is without effect on normal fasting blood sugar, but reduces the hyperglycemia of human diabetes. It greatly increases glycogen storage in the liver, but probably not

directly as does insulin or as Collip's "glucokinin," a plant insulin, but as secondary to its pancreatic effect. Its action seems a direct one on the pancreas, as a metabolic stimulant or as a source of supply of an insulin precursor.

Riddle[9] found the blood sugar relatively high in patients with pernicious anemia (achylia); with a decrease in blood sugar during early remission, as low as 61 mg. and associated with an increase in appetite, caloric intake and body weight. The hypoglycemia appears to be related to a metabolic adjustment of the liver to normal glycogen storage.

The glycogen-insulin mechanism is shown by Okada[10] to be vital in the physiologic process of oxidation, as an incessant oxidation of sugar is unconditionally necessary to maintain the living process. The regulatory influence of this active sugar on the function of the digestive tissues is similar to that of oxygen on the function of the respiratory organs. A deficiency either of oxygen or sugar stimulates the parasympathetic or vagal centrum; oxygen lack producing forced respiration, hypoglycemia digestive hypersecretion and hypermotility (hunger). He has demonstrated that amino-acids and fats stimulate the parasympathetic nervous system: the former, the centrum that controls the gastric secretion, and the latter mainly the centrum that controls the pancreatic and biliary secretions. Such substances might be called the "humoroneural excitants of the secretions of the digestive juices."

TABLE I

ANALYSIS OF 100 CASES OF BILIARY TRACT DISEASES

Chronic cholecystitis	62
Acute cholecystitis	6
Atony of the biliary tract	5
Cholelithiasis	23
Jaundice	4
	100

TABLE II

ACIDITY IN CHRONIC CHOLECYSTITIS

	Cases	Per Cent
Hyperchlorhydria	12	20
Euchlorhydria	6	9
Hypochlorhydria	44	71

TABLE III

ACIDITY IN CHOLELITHIASIS

	Cases	Per Cent
Hyperchlorhydria	17	74
Euchlorhydria	4	17.4
Hypochlorhydria	2	8.6

TABLE IV

ACIDITY IN ATONY OF BILIARY TRACT

	Cases	Per Cent
Hyperchlorhydria	5	100

ACIDITY IN JAUNDICE, ACUTE, TOXIC

	Cases	Per Cent
Hyperchlorhydria	4	100

Dextrose on the contrary is "the humoro-neural inhibitant."

The 100 cases here reported were especially selected to refute the contention of some writers, namely, that duodenal regurgitation is the chief cause of hypochlorhydria, or even achlorhydria, in diseases of the biliary tract. If a bile-tinged color of the gastric contents is evidence of duodenal regurgitation, not one of the cases with hypoacidity showed even a trace of visible bile except in an occasional isolated fraction. On the contrary bile appeared, in our series, rather in the cases with hyperchlorhydria. Also recognizing the direct relationship of the age incidence and a lowered gastric acidity, we were struck by the number of the older patients who had normal to hyperacid figures.

The chief points of interest in the tables, printed here, seem to be the incidence of hypochlorhydria in 71 per cent of the cases of chronic cholecystitis; and the incidence of hyperchlorhydria in 74 per cent of cases of cholelithiasis. These figures confirm the results of the majority of other writers in this field of investigation.

CONCLUSIONS

1. Gastric hyperacidity is associated with acute disease of the biliary tract and with uncomplicated cholelithiasis whether of short or long duration. Gastric hypoacidity and achlorhydria are associated with chronic disease of the biliary tract.

2. Stress is laid on a newly described humoroneural regulation of gastric, pancreatic and biliary secretion. It is bound to receive the recognition it deserves as a

TABLE V

CHANGES IN GASTRIC ACIDITY FOLLOWING TREATMENT FOR GALL-BLADDER DISEASE

No.	Diagnosis	Therapy	Acidity and Curve Before (T. F.)	Acidity and Curve After (T. F.)	Result
1	Cholelithiasis	Cholecystectomy	11-1-26 114-62 s.	9-8-30 40-20 n.	Cured
2	Cholelithiasis	Cholecystectomy	1-9-27 93-83 c.	4-11-30 42-26 n.	Cured
3	Cholelithasis	Cholecystectomy	3-12-26 109-57 c.	4-8-30 50-30 n.	Cured
4	Cholelithiasis	Cholecystectomy	3-3-26 33-16 L.	4-15-30 45-30 n.	Cured
5	Cholelithiasis	Cholecystectomy	2-1-30 28-14 L.	9-14-30 52-27 n.	Improved
6	Cholelithiasis	Biliary drainage	2-21-30 30-30 s.	9-5-30 64-36 n.	Improved
7	Acute cholecystitis	Biliary drainage	2-10-29 71-50 c.	4-2-30 60-39 n.	Improved
8	Acute cholecystitis	Biliary drainage	1929 98-67 c.	4-2-30 67-50 n.	Improved
9	Acute cholecystitis	Biliary drainage	3-21-28 70-56 s.	10-29-29 56-31 n.	Improved
10	Acute cholecystitis	Biliary drainage	10-13-28 71-62 s.	9-17-30 52-30 n.	Improved
11	Acute cholecystitis	Biliary drainage	8-22-29 120-80 c.	5-2-30 95-70 n.	Improved
12	Acute cholecystitis	Biliary drainage	10-20-29 56-24 c.	7-21-30 46-22 n.	Cured?
13	Acute cholecystitis	Biliary drainage	5-25-29 98-77 c.	4-14-30 60-39 c.	Improved
14	Chronic cholecystitis	Biliary drainage	9-13-28 36-13 s.	6-3-30 58-35 n.	Improved
15	Chronic cholecystitis	Biliary drainage	6-23-28 89-81 s.	5-5-30 58-45 n.	Improved
16	Chronic cholecystitis	Biliary drainage	5-23-29 30-16 s.	6-11-30 56-23 n.	Improved
17	Chronic cholecystitis	Biliary drainage	6-21-28 30-10 L.	8-22-29 70-40 n.	Cured?
18	Chronic cholecystitis	Biliary drainage	12-21-29 30-14 L.	2-28-30 50-29 n.	Cured?
19	Chronic cholecystitis	Biliary drainage	9-15-29 13-0 L.	4-2-30 57-34 s.	Cured?
20	Atony of gall bladder	Biliary diagnosis	12-22-28 78-32 s.	4-15-30 64-35 s.	Improved
21	Gallstone. Gardiasis	Cholecystectomy	11-22-29 46-24 s.	9-20-30 40-16 n.	Not improved

Note: s signifies sustained curve; c is for continuous; L for low curve; N for normal. T signifies total acidity; F free hydrochloric acid.

valuable acquisition to our knowledge of the humoral regulation of digestive tract secretion and motility.

3. This mechanism, bound up with the glycogen-insulin function of the liver and pancreas, is deranged especially through hematogenous infections and toxemias carried by the portal blood, and disseminated, by way of the connecting lymphatic system, among the liver, gall bladder, pancreas and stomach. The glycogen-insulin function is the first to be affected by infection and intoxication states.

4. The structural and functional disturbance of the entire hepatoenteric system together with a toxic derangement of the splanchnic nerves supplying it, form a syndrome that makes up the broad but probably truer conception of gall-bladder disease.

5. There is a tendency to a return to normal gastric secretion with the disappearance of symptoms of biliary tract disease, following non-surgical drainage, operation, or both. The return to normal gastric secretion was longest delayed in the postoperative patients.

6. The finding of persistent hydrochloric acid deficiency should not be interpreted as an isolated functional or disease entity, but should point first and rather with suspicion to some possible pathology in the biliary tract.

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DISCUSSION

Dr. Ivy: I do not like particularly to criticize anyone, or his work destructively, but in this case, I think the essayist has gone beyond the facts, so far as the explanation is concerned. When one uses the observations of Okada and others to explain achylia, I think that is going beyond the facts. Perhaps these observations do have some bearing on the problem of achlorhydria and hyperchlorhydria, but certainly there are less hypothetical explanations for these conditions. There is a condition which is generally recognized and observed, which causes considerable trouble so far as gastric acidity and symptoms are concerned and that is pylorospasm or reflex gastric disturbances. We know that a diseased condition of the alimentary tract may produce reflex gastric disturbances. We know that gastric retention increases the gastric phase of gastric secretion, and that disturbances of intestinal digestion affect gastric secretion. Is this not a more simple explanation of the changes in gastric secretion in gall-bladder disease than a hormone imbalance hypothesis? In order to know the effect of a diseased condition on gastric secretion, we must make observations before and after the onset of the disease. This is frequently impossible in man. In animals it is possible. We have found by studying gastric secretion before and after cholecystectomy that if there is any change it is slightly increased. We accounted for this by the more or less continuous elimination of bile into the intestine which favorably affected intestinal digestion.

Now, Okada reports that the injection of insulin causes a change in gastric secretion. But one cannot say whether he observed the effect of insulin or some impurity in it, since insulin is about 90 per cent impure and for all we know, his insulin may have had some histamine in it. We have injected insulin into our dogs and failed to observe any effect on their gastric secretion. They secreted gastric juice while manifesting hypoglycemic convulsions. So one must be careful in making hypotheses on the basis of results obtained by injecting impure solutions of hormones in unphysiological amounts.

Dr. Lueders (*closing*): The criticism that Dr. Ivy has directed against Okada and his associates should be directed toward me. The reason for my making such enthusiastic statements was because I thought that this mechanism is probably one way in which we may get to understand the relationship between the stomach and the gall bladder, as well as the liver and the biliary tract. Okada made no such claim for his findings.

In regard to cholelithiasis and the return of gastric secretion to normal following cholecystectomy, I take it that Dr. Ivy did not wait two or three years in his studies, to note the acid figures over that period. If he had done that, he might have found his gall-bladder cases had returned to normal acid figures.

In regard to the purity of insulin used, Okada proved very conclusively that his insulin had no effect, while his histamine had a very pronounced effect, on gastric acidity in the presence of hyperglycemia, and that only in cases of hypoglycemia does insulin act to produce hyperchlorhydria.
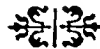
GASTRIC SYPHILIS

DATA ACCUMULATED FROM 89 CASES*

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OPINIONS in the literature concerning gastric syphilis are controversial. There are two schools of thought. One of them is composed of those who insist that the recognition of the Spirochaeta pallida in the tissue excised from a gastric lesion is necessary in order to make a diagnosis of gastric syphilis. In the second school it is believed that a similar diagnosis is justifiable in the case of syphilis in which a demonstrable gastric lesion is materially altered by antisyphilitic treatment, when the alteration is accompanied by relief of the gastric symptoms. The discussion is between the microscopist and the empiricist.

Gastric syphilis may be more common than the literature indicates, but less than 0.3 per cent of the syphilitic patients seen in the Mayo Clinic have had gastric syphilis. Andresen noted 4 cases in 202 syphilitic patients, and Meyer noted 5 cases in 1800 roentgenographic examinations of the stomach. Hartwell called attention to the fact that the character of the subjective complaints of patients with gastric syphilis is bizarre. Eusterman reported on the clinical manifestations of a portion of the cases included in this study and emphasized the following facts: The average age incidence was thirty-five years, and the average duration of the complaint was two years; achylia was noted in 85 per cent of the patients, and there was infrequent occurrence of gastric retention and palpable mass, although roentgenologic evidence simulated most closely the appearance in scirrhous carcinoma. The historical data, in many cases, revealed gradual but steady decrease in the capacity of the stomach, in spite of which good appetite often was maintained. Vomiting usually gave immediate relief from the distress that appeared after eating. In commenting on the diagnosis of gastric syphilis, Stokes gave the gastroenterologist a 25 per cent advantage over the roentgenologist in arriving at a definite diagnosis. In practice, the advantage of the gastroenterologist, I believe, is even greater, because the concomitant observations are so essential to a diagnosis.

This report is based on a study of 151 cases in which demonstrable gastric lesions were found, and in which, in addition, the patients had syphilis or were suspected of having syphilis when they were referred to the Section on Dermatology and Syphilology. I have excluded cases in which there were gastric complaints associated with acute syphilis, cases of syphilitic patients with duodenal ulcer, and cases in which the evidence for gastric carcinoma was indisputable, even though clinical syphilis also was demonstrable. Before a definite diagnosis was made, each of these 151 cases was subjected to a group of criteria which included the available diagnostic procedures utilizable in the recognition of gastric syphilis, in addition to periods of observation of at least two years. In fact, the periods of observation ranged from two to nine years. As a result of these requirements, it was found that 36 of these patients had syphilis and gastric carcinoma, 17 had syphilis and simple gastric ulcer, 9 could not be traced, and in 89 a diagnosis of gastric syphilis eventually was made.

The following criteria were demanded in making the diagnosis of syphilis of the stomach: (1) a therapeutic test for gastric syphilis, consisting of observation of the effect of arsphenamine and mercury, or bismuth, was interpreted as successful only after a period of observation of two

years; my conception of what constitutes a successful therapeutic test will be elaborated subsequently; (2) exclusion of carcinoma and simple ulcer by histopathologic study at operation or at necropsy, or recognition of the histopathologic evidence of syphilis some time after operation, in tissue excised at operation; (3) roentgenologic demonstration of a gastric lesion which had the characteristics that have been frequently described as those of gastric syphilis; (4) clinical evidence of gastric syphilis and the interpretation of the concomitant finding. Moreover, the fact was kept in mind that the recognition of clinical evidence of syphilis is less significant in the diagnosis of gastric syphilis than is the presence of concomitant data in favor of gastric carcinoma or gastric ulcer. I have placed these criteria in the order of their practical diagnostic significance, and although I believe that each one is sufficiently important to warrant individual comment and elucidation, the diagnosis was most often the result of correlation of the combined procedures.

THERAPEUTIC TEST

The estimation of the response to antisyphilitic treatment, in conjunction with a prolonged period of observation, offers the most practical method of arriving at a diagnosis of gastric syphilis. I fully realize that such a statement is debatable, but I trust the subsequent evidence I offer will support this contention. Emphasis concerning some of the essential requirements of the therapeutic test is worthy of attention.

The differential diagnosis between gastric carcinoma and gastric syphilis may be difficult. It is my practice to give the differential therapeutic test while the patient is in the hospital, under close observation, where the intake of food can be measured and the same type of diet can be maintained throughout the test. When possible, the patient is given a "general mixed" diet, and if the gastric capacity is markedly reduced, the daily ration is divided into from four to six meals instead of the customary three. A daily record of weight is maintained, and frequent estimations of the degree of anemia and its variations are made. Medication, other than antisyphilitic remedies, is discontinued. A syphilitic lesion of the stomach is one of the forms of visceral syphilis in which a Herxheimer reaction (increase in the size of a gumma following an initial injection of arsphenamine) is not encountered that is severe enough to contraindicate the liberal use of arsphenamine early in the course of treatment. Accordingly, arsphenamine in doses of from 0.2 to 0.5 gm. is given weekly, coincidentally with inunctions of mercury or daily intramuscular injections of the succinimide of mercury.

The most difficult aspect of the therapeutic test is the determination of just how long the test should be continued. The type of the gastric lesion, as revealed by the roentgenogram, its situation, the duration of the lesion, and the general condition of the patient, are factors which influence such a decision. Morphologically, there are 7 types of gastric syphilis, varying from the simple gumma to diffuse fibrotic involvement of a greater portion of the stomach. In the type with single or multiple gummas, irrespective of their situation in the stomach, and irrespective of a comparatively short history, favorable therapeutic effects are usually manifested in two weeks, and occasionally earlier. However, the hour-glass type or fibrotic type of lesion may show slight, if any, clinical improvement, even following prolonged treatment. It is unwise to attach too much significance to the relief of gastric symptoms early in the course of the therapeutic test. I have observed patients with gastric carcinoma, simple gastric ulcer, and linitis plastica display great enthusiasm following the first or second injection of arsphenamine, due perhaps to psychic effects or to the non-specific effect of the arsenic. A persistent and steady gain in weight, accompanied by a decrease of the

anemia, and the ability to eat larger amounts of food, with less discomfort, are of more significance than changes in the patient's subjective complaint. When these phenomena occur coincidentally and in a marked degree, the result of the therapeutic test is startling. If gastric carcinoma is present in a patient with latent syphilis, the temporary flare of improvement in the subjective complaint is usually followed by slow loss of weight and strength, with failure to show improvement in the other manifestations previously mentioned. Although 5 of the patients in this study gave a history of hemoptysis, and blood was demonstrated in the stools of 4, I have never observed a gastric hemorrhage in a patient with gastric syphilis undergoing a therapeutic test. Such accidents have occurred, however, not infrequently in cases of gastric carcinoma under therapeutic test. In those patients who have responded satisfactorily to the first course of 6 injections of arsphenamine, and of a corresponding amount of mercury, at least 3 more courses of similar amounts are recommended at intervals of four months, and in the intervals, mercury or bismuth is administered.

In addition to the use of antisyphilitic remedies, a period of observation, frequently a prolonged one, is essential to the therapeutic test. The wisdom of maintaining the period of observation is obvious in those cases in which the patients derive a non-specific effect from the arsphenamines, and particularly in the low-grade type of gastric carcinoma in which the progress of the disease is slow. The cases in which it is most difficult to appraise the therapeutic test are those with diffuse or extensive gastric involvement of the fibrotic type. The phenomenon of spontaneous involution, of the type of gastric syphilis with fibrosis, is of rare occurrence, and is particularly hard to demonstrate clinically early in the course of the disease. I do not believe a diagnosis of "leather bottle stomach," if the term infers syphilitic etiology, is justified with-

out histopathologic study of excised tissue to exclude the presence of carcinoma.

The criteria which I have used for a positive therapeutic test consist of rapid and persistent symptomatic relief of the gastric symptoms, coincident with gain in weight and strength, decrease of anemia, and increasing appearance of well-being, augmented by persistence of improvement for at least two years. In about half of the cases, anatomic change in the gastric deformity may be anticipated, while changes in the gastric chemical determinations, although occasionally present, are less significant. The degree of symptomatic relief, and the amount of anatomic change, are dependent on the type of the gastric lesion. An appraisal of the results of treatment, after periods of observation ranging from two to nine years, shows the following: of 81 patients, 37 per cent are clinically "cured"; the condition of 27 per cent is improved and of 29 per cent is unchanged; 7 per cent are dead. The present status of the 8 other patients of the 89 who had gastric syphilis is unknown. By clinical cure I mean the disappearance of gastric distress and the ability to eat the average wholesome diet without symptoms. This interpretation was based solely on the patient's statement and was made irrespective of the roentgenologic observations at that time. The group in which the condition was reported as being improved, included patients who still had subjective complaints, but of a less marked degree. They were, in the main, patients with extensive gastric involvement when treatment was started, and with complaints of long duration. Those whose condition was not improved were contending with a contracted stomach, the result of interstitial fibrosis, and were greatly embarrassed by the small capacity of their stomachs. In this type of patient neither continued antisyphilitic treatment nor plastic gastric surgery offers relief.

The problems in the treatment of gastric syphilis resemble those in the treatment of other forms of visceral and neurologic

syphilis. The disease is characterized by its destructive ability, its occasional spontaneous involution, and the rapid response to treatment of the active manifestations. Unfortunately, the resulting scarring, whether in the skin, aorta, or stomach, is productive of subjective or objective signs, or both. Hence, the necessity for early recognition of gastric syphilis and for institution of intensive antisyphilitic treatment is obvious.

HISTOPATHOLOGIC AND GROSS PATHOLOGIC STUDIES

There were 36 patients in this series who had gastric carcinoma and syphilis in one form or another. In 16 cases, the diagnosis of gastric carcinoma was made histopathologically at the time of operation, following an unsuccessful therapeutic test. In the remaining 20 cases, the evidence favored a diagnosis of gastric carcinoma at the outset; but because the lesion was of the inoperable type, and because the accompanying signs of visceral carcinoma were less pronounced than those usually noted, the patient was given a short therapeutic test for syphilis before being dismissed as incurable. There were 17 patients with simple gastric ulcer and syphilis, and practically all of them were referred to my care with the combined diagnosis. Antisyphilitic treatment was given while the patient was undergoing medical treatment for the ulcer, or was in preparation for operation. The incidence of correct diagnosis emphasized the fact that the obstacles to differential diagnosis between gastric ulcer and gastric syphilis are less frequently encountered and are less difficult than those encountered in making a differential diagnosis between gastric syphilis and gastric carcinoma.

There were 19 patients in the group with gastric syphilides, from the stomach of each of whom a section was removed and examined histopathologically. Spirochaeta pallida was not found in any case. In 9 the pathologist reported the tissue as syphilitic, and in 4 as "probably syphi-litic"; in 5, the report was of inflammatory tissue. The Section on Pathologic Anatomy, in its necropsy service, has found 3 cases of gastric syphilis, in all of which the diagnosis was made before death, and in which death was due to other diseases.

The literature indicates that syphilis of the stomach is manifested in 7 different varieties: (1) multiple ulcers (gummas), (2) single ulcers, (3) diffuse gummatous infiltration, (4) nodular-ulcerative lesions, (5) chronic interstitial fibrosis, (6) nodule, and (7) linitis plastica (Singer-Meyer). The macroscopic appearance of the stomach in gastric syphilis is not sufficiently well known in this country to permit of diagnosis in the operating room, unaided, in any but a small percentage of cases. The comparative rarity of the disease, its varied manifestations, and its resemblance to carcinoma make the diagnosis difficult. Luria reported that in Russia the diagnosis usually is made at the time of operation as a result of the large experience Russian surgeons have had with visceral syphilis. The presence, for example, of visceral syphilis and in particular of hepatic syphilis, may lead to the suspicion that gastric syphilis is present. However, the report of the pathologist, excluding carcinoma, is the basis for the tentative diagnosis in the majority of cases at the time of operation.

Hartwell reviewed the literature up to 1925; he found only 25 cases in which he felt that the diagnosis of gastric syphilis had been substantiated by the pathologic data. However, he was unable to determine what constitutes the classic histopathologic picture of gastric syphilis because of the varied descriptions that have been given. That it is necessary to demonstrate the Spirochaeta pallida in the excised tissue in order to make an absolute diagnosis is prominent among the criteria demanded by some authors. Only two investigators, Warthin and McNee, have reported successful demonstration of the organism. Singer and Dyas doubted that the organisms found by McNee were Spirochaeta pallida, and

expressed the belief that they were Vincent's spirilla. Hartwell, however, accepted McNee's observations as authentic. Warthin reported that he has demonstrated the Spirochaeta pallida in 8 cases of gastric syphilis, in practically all of which operation was done because of a diagnosis of peptic ulcer. The incidence of the demonstration of the Spirochaeta pallida in the gastric ulcer of the gummatous type no doubt will be higher in the hands of pathologists who become expert in its identification. As Hartwell noted, the histopathologic description of gastric syphilis has not as yet become sufficiently well recognized by general pathologists to enable unequivocal diagnosis to be made. In the chronic interstitial fibrotic type of gastric syphilis, in which the finding of the Spirochaeta pallida has not as yet been reported, and in which the typical microscopic picture has not, as yet, been described, the diagnosis is made primarily by exclusion on the basis both of clinical and histopathologic data.

Singer and Dyas also called attention to the fact that it is difficult to describe a classic histopathologic picture of gastric syphilis because of the fact that the disease is not only seen in a variety of forms, but also because it is a transitory disease. Singer emphasized the latter point by endeavoring to show that certain cases of linitis plastica are the end-stages of diffuse interstitial syphilitic fibrosis. There was 1 case in my series that substantiated Singer's suggestion, but the study of 38 cases of linitis plastica in the Mayo Clinic, reported by Lyons, showed that linitis plastica is a manifestation of small-cell carcinoma.

Gastric syphilis is analogous histopathologically to hepatic syphilis. The endstage of hepatic syphilis, namely, syphilitic cirrhosis of the liver, cannot be recognized as a syphilitic process, either macroscopically or microscopically. However, during the active phase of gummatous hepatitis, the histopathologic picture may be definite. On the other hand, syphilitic hepatic cirrhosis is difficult to diagnose under the microscope. The same may be said of gastric syphilis. Gastric gummas are not only readily recognizable histopathologically but they offer the likelihood of demonstrating the Spirochaeta pallida. The diffuse interstitial fibrotic type of gastric syphilis does not present a picture characteristic of syphilis or the possibility of demonstrating the organism. In other words, various pathologic pictures are to be found in gastric syphilis, some of which are specific, whereas others are non-specific. Accordingly, it is impossible to demand a histopathologic diagnosis in all cases. Hence, the need for recording in the literature reports of the various pathologic pictures of gastric syphilis, as encountered from time to time, is obvious. Likewise, the criteria for diagnosis should be modified so as to demand a histopathologic diagnosis in the type of case in which it is feasible.

ROENTGENOLOGIC FEATURES

It has been my experience that the roentgenologist, at times, may make the diagnosis of gastric syphilis unequivocally. However, he more frequently raises the question of the existence of possibility of syphilis. Gastric syphilis was more frequently misdiagnosed as gastric carcinoma than as any other lesion in this series. The presence of the personal equation was obvious in this study, indicating that the suspicion of syphilis was entertained by different roentgenologists in varying degrees. This factor is always of paramount importance in interpreting the results of any clinical examination for syphilis. It does not seem necessary to give the characteristic roentgenologic morphologic changes in gastric syphilis, for they have been ably enumerated by Carman and more recently by Moore and Aurelius. However, for emphasis, mention may be made of the need of recognizing the concomitant features, such as disproportionate loss of weight, absence of cachexia, slight anemia, persistent appetite, the ability to obtain relief from vomiting, and a long history of gastric complaint.

In the 89 cases, the roentgenologist diagnosed 44 as gastric syphilis. Thirty-two, which were diagnosed as carcinoma, were later proved by my requirements to be cases of gastric syphilis. The 89 cases, it will be remembered, constituted a group in which the diagnosis of gastric syphilis finally was established. There were 62 others, making 151 in all, in which demonstrable gastric lesions and syphilis were present but the presence of gastric syphilis was not established. Of these 62, 6 were diagnosed as syphilitic ulcer of the stomach, only to have the diagnosis changed to carcinoma later. These diagnoses were made by the roentgenologists solely from the roentgenologic data, and indicate an incidence of roentgenologic diagnosis that is higher than the average. In 21 of the 47 cases in which roentgenologic studies were done, following one or two courses of treatment, varying degrees of improvement were seen in the changes in the gastric deformity. There were 16 of the 47 cases in which noteworthy changes were not observed by roentgenologic methods, but in which there was symptomatic "cure." McGlannan has also called attention to cases in which the features were like those of these 16.

CLINICAL EVIDENCE OF SYPHILIS

The clinical evidence for syphilis was sought in the Section on Dermatology and Syphilology. Little, if any, attention was paid to a history of chancre or to the other manifestations of acute syphilis, and neither was one report of Wassermann reaction accepted as final. In all the cases in which clinical evidence of syphilis was not recognized, a provocative Wassermann procedure was carried out or a Wassermann reaction was done each day for five to seven days. In the last four years, the Kolmer and Kahn tests have been done simultaneously in all dubious cases; an examination of spinal fluid was done in all cases except in patients aged more than fifty-five years and in a few who were too acutely ill to be subjected to the procedure.

Of the patients with gastric syphilis, 27 per cent had other clinical signs of syphilis. In 9 patients (11 per cent) there were positive findings in the spinal fluid. Seventy-three per cent had repeatedly positive Wassermann reactions of the blood, as the only evidence of syphilis other than the roentgenologic features. There were 6 patients who had negative Wassermann reactions, and who were proved to have gastric syphilis. The clinical signs of syphilis, in 27 per cent of the cases, may be compared with the 16 per cent of the patients who had gastric carcinoma and syphilis, and also clinical signs of syphilis. The demonstration of clinical evidence of syphilis in a patient with an indeterminate type of gastric lesion does not warrant a diagnosis of gastric syphilis, because the incidence of positive clinical signs of syphilis was almost as high in the patients with gastric carcinoma as in those with gastric syphilis.

SUMMARY

Eighty-nine of a group of 151 patients with gastric lesions and syphilis were found to have gastric syphilis. These were selected from among approximately 25,000 patients with syphilis. The diagnosis was based on the combined results of prolonged therapeutic tests, histopathologic studies, morphologic changes in the roentgenologic characteristics, and restoration of gastric function. The demonstration of the existence of other evidence of clinical syphilis is not pertinent to the diagnosis of gastric syphilis. Of the 89 patients with gastric syphilis, 73 per cent had positive Wassermann reaction of the blood as the only other evidence of syphilis, and 6 per cent had negative serologic reactions. The incidence of clinical signs of syphilis was almost as high in those cases with gastric carcinoma (16 per cent) as it was in those with syphilides of the stomach (27 per cent). Recognition of the Spirochaeta pallida in excised gastric tissue as the conclusive means of diagnosis is a diagnostic requirement demanded by the scientific

purist. I would prefer to see among the diagnostic criteria for gastric syphilis one demanding a histopathologic study to eliminate carcinoma. Although the Spirochaeta pallida may be demonstrated in the gummatous type of gastric ulcer, in cases of diffuse syphilitic fibrosis the organism has not as yet been recognized. Numerous instances of the bizarre character of both the clinical and microscopic features of gastric syphilis merely confirm the knowledge that syphilis is a protean disease.

The incidence of cure in gastric syphilis is less than the occasional cases with dramatic improvement leads us to believe. In this study, 37 per cent were cured, and the condition of 27 per cent was improved. The result of treatment in the fibrosed syphilitic stomach is unsatisfactory, and plastic gastric operation offers slight help. Linitis plastica is a term that should be reserved for small-cell carcinoma of the stomach, and should not be used in relation to gastric syphilis because of the attendant confusion. Spontaneous involution or antisyphilitic treatment may account for the fibrotic leatherbottle stomach, for which the name of gastric syphilitic fibrosis is suggested. In patients in whom the gastric lesion is reported as operable but of indeterminate type the therapeutic test should be limited when the response is exceptionally slow and an exploratory laparotomy done, rather than subject the patient to a too prolonged test.

As in all forms of syphilis, early diagnosis and early institution of treatment are rewarded by a higher incidence of cure than is obtained otherwise, a fact forcibly emphasized by this study.

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DISCUSSION

DR. BOCKUS: About two years ago we analyzed a series of 22 cases in which syphilis was associated with lesions in the upper portion of the intestinal tract, and the two pertinent things which we noticed at that time were, a marked tendency to cardiospasm with some dilatation of the esophagus and duodenal stasis. I would like to know if Dr. O'Leary has not noted in some of his cases this tendency to multiplicity of roentgen defects in gastric syphilis. We had a very unfortunate experience in our cases with an ulcerating type of gastric lesion. Two of them perforated while undergoing treatment in spite of the fact that we were very cautious in the use of neoarsphenamine. I would like to know if Dr. O'Leary has had a similar experience.

DR. MOORE: I take this occasion to report the end-results of a treatment reported on, several years ago. There was at that time a considerable difference of opinion regarding the diagnosis of this condition as syphilis, but we felt sure that it was syphilis, from the clinical behavior, the laboratory findings and the response to the laboratory tests. The patient was treated for syphilis, and died last fall, and we did get a chance to examine the pyloric portion of the alimentary tract, and it showed no signs of an epithelial growth, thus justifying our clinical findings.

DR. SMITHIES: I just want to take this

occasion to state that 5 of our 12 patients whom I reported on several years ago, and who had definite, palpable tumor, with symptoms of syphilis, are still living, and, apparently, "going strong." We have to push the medical treatment very strongly, in those cases, giving them sometimes as high as 240 grains of potassium iodide in ½ gal. of water daily and keeping that up as long as we can get them to continue it. It is quite expensive.

Dr. O'Leary, (closing): I was particularly interested in Dr. McGlannon's further report of the case he recorded several years ago. The diagnosis of gastric syphilis made by Dr. McGlannon at that time seems conclusively proved by this subsequent observation. I made no mention in my presentation of the changes in the gastric chemistry of patients with gastric syphilis following antisyphilitic treatment, but it is our experience that the majority of cases who have not developed gastric fibrosis show a return to normal. The point brought up in regard to duodenal stasis was well made. I have not seen a case of gastric syphilis with evidence of perforation, although gastric retention has not been an uncommon finding in my cases. The presence of a palpable gastric tumor was noted in 7 of the last 10 cases of gastric syphilis I have seen. When a suspicion of gastric syphilis is aroused the therapeutic test for syphilis is the ideal manner in which to substantiate or disprove the suspicion. The need for surgical intervention and the opportunity for histologic diagnosis are dependent on the success or failure of the therapeutic test.
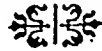
THE NEED FOR "STANDARDS" IN INVESTIGATIVE AND THERAPEUTIC WORK IN GASTROENTEROLOGY*

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IT has always appeared to me that on such occasions as this, the opening remarks of your President should be more suggestive than didactic. Annually, opening remarks might serve to emphasize steps in the progress of our specialty, or to indicate along what lines profitable endeavors might be directed with respect to diagnosis and treatment.

In accordance with this interpretation of the functions of a presidential address, it seems advisable to direct your attention to the need for what one might term "standards" in research, routine clinical diagnostic methods and of appraising the results of treatment.

I hesitated a long time before choosing the word "standards." I am well aware that the application of the word "standard" to an investigative method or to a form of clinical management might imply a certain lack of individual cerebration or of effort directed to meeting the requirements of the particular patient. Furthermore, emphasis upon "standards" carries the disagreeable suggestion of mechanical aids and, perhaps, an attempt coldly to fit a subject to a system. However, it seems to me that in the field of our ordinary everyday effort, the necessity for "standards" is quite as essential as is the establishment by governmental bureaus of standard procedures by which time, space, length, breadth, color, weight, etc., can be described. It is only by the accumulation of material conveniently arranged and indexed after a similar fashion, that, we can correctly appraise results and evaluate progress in our special field. Just as among governments, there is an international agreement as to what constitutes a liter or a quart, a meter or a yard, a volt and ohm, so does it seem to be necessary that among gastroenterologists, standards of procedure, whether investigative or clinical, be established that clinicians and laboratory workers may speak the same language about similar or dissimilar things.

Let me take one phase of routine or of research work dealing with the stomach, namely, the determination of gastric secretion in health or in disease. Since the time of the older gastroenterologists, notably Ewald, Boas, and Kussmaul, the most common clinical method for estimating gastric secretion has been by means of a test meal, administered when the stomach presumably was empty, and its effect noted as a digestive stimulus over an arbitrarily set time-period of one hour. Probably millions of such test meals, or variants of them (bread and water, tea and toast, shredded wheat biscuits and water, etc., etc.) have been administered, apparently with little questioning as to their being a suitable load capable of initiating and maintaining gastric work. The meals have been left in the stomach, anywhere from forty-five minutes to an hour following the ingestion of the last morsel, and at the end of the time-period, the stomach has been emptied, usually with the aid of a tube or, in the last few years, by a Rehfuss or similar tube constantly in the stomach, the fractions of the meal being removed at intervals of a few minutes.

The physiologic facts of digestion are that carbohydrate cleavage begins and is carried to a fairly advanced stage in the mouth and in the esophagus; gastric digestion largely is concerned with beginning the digestion of proteins. Yet, in health as well as in disease, clinically, the attempt is made to gauge the digestive capacity of the stomach, an organ having to do with the initiation of peptic digestion,

by a meal which is from 75 to 90 per cent carbohydrate, and whose physical character is such, that its puree-like mass begins to emerge from the normal stomach within a few minutes following its reception.

It is by such feebly stimulating and unphysiologic agent that there has been recorded the capacity of the stomach for peptic digestion in health and in disease. From such records one can say only, that a test meal as the Ewald or its variants, represents nothing more than what response, secretorily, an individual stomach gives at a particular time, when a carbohydrate meal initiates and carries on carbohydrate digestion in the mouth, throat and esophagus, and what response an individual stomach makes at a particular time, when a smooth food mass acts mechanically through a given time-phase upon the gastric mucosa. Doubtless, test meals as the Ewald were first exhibited because it was felt that, in dyspeptic individuals, the ingestion of a small non-irritant food mass would be well borne and not cause pain or vomiting. Possibly, too, such a simple meal was easily withdrawn and when color changes were employed to test acidity and peptic activity, there was little, if any, interference, with their recognition. Such a simple meal likewise facilitated microscopic examination. However, one cannot say, by the widest stretch of the imagination, that meals of the Ewald type are, in individuals or in groups, indices of the secretory or the motor capabilities of the stomach. These meals have become "standard" in the unfavorable sense of the word, namely, they have been given without thought of their physiologic significance. It is true, that if at the hands of many physicians, these meals are administered, one can say that the results are of a certain comparative worth, that is, comparative worth of an indirect nature: namely, they indicate what a carbohydrate meal will do toward the excitation of secretion and movement in an organ equipped for the digestion of non-carbohydrate food. The foundations

of our investigative work in gastric indigestion rest largely upon evidence secured by Ewald-like meals in this way. It would be interesting to surmise what racial variations would be presented when gastric secretion was estimated by such carbohydrate meals in races whose food is largely carbohydrate (as Italians, vegetarians, etc.) and those whose food is largely protein and fat (Eskimos, Nordics, savages and the like).

Certainly, it would seem that if clinicians and students are to place any reliance whatever upon the test meal study of gastric function, meals must be employed which call forth not only, primarily, digestive secretion in the stomach itself but the secondary or hormonal effects of properly initiated and maintained gastric digestion upon pancreatic, hepatic and enteric secretion and motility.

But I hear the criticism that I am not entirely fair to the gastroenterologist, because it is said he does employ meals which do give opportunity for the initiation and development of a digestive cycle in response to protein stimulation. In a measure, criticism is just. Such full dinners as that suggested by Riegel are a true index of the digestive capabilities of the stomach, because not only do such meals excite the carbohydrate digestive efforts in the mouth and esophagus and the digestive activity of the pancreas, liver and jejunum, but they furnish adequate bulk for gauging the motor integrity of the stomach. Such a meal is entirely physiologic whether it is removed fractionally at quarter hour intervals, as long as any of it remains in the stomach or whether it is removed en masse at a time arbitrarily set (two to four hours). Particularly is such a meal helpful if it is selected by the patient to suit his likes and dislikes and to conform with his racial or environmental customs. But, here again we are faced with the need of standards because there has nowhere been established a set custom as to whether the meal should be removed fractionally or if removed en masse at what hour after

the completion of its ingestion should it be removed. It is well known that what I choose to call "velocity of digestion" varies greatly in individuals of the same age and sex, in different races, and, in these various meal recipients, at different times, dependent upon many such elements as season, the emotions, fatigue, exercise, etc. Be it admitted that various difficulties can be overcome clinically or in research, and that such a meal represents as nearly as possible the true status at a given time in a given individual of his digestive capabilities toward a particular meal, yet, *it is not upon figures derived from such studies that our ideas, or one might say our standards, have been established.* They should be: the whole question of gastric response to food needs re-doing, on the basis of physiologic principles.

One can search in vain through the literature to find results of studies in these directions. In other words, we lack standard information upon what in *health* the stomach is able to do digestively toward *mixed meals,* when physiologically considered. Not only do we lack such standards for the human family as a whole, but they are lacking with respect to digestive variations in the different decades of life, the sexes, the races, in different seasons and so forth.

Based largely upon the results secured with the Ewald meal, an extensive literature regarding hydrochloric acid and pepsin values associated with disease of the stomach, particularly ulcer, has appeared, most of which is worthless. Upon such evidence, it is commonly assumed that peptic ulcer is accompanied by hyperchlorhydria, and, in fact, very often it is assumed in general practice that hyperchlorhydria *means* ulcer. It is extraordinary how rapidly this attitude toward ulcer has translated such clinical symptoms as heartburn, pyrosis and water-brash into "hyperchlorhydria." These clinical symptoms, known to the laity under the general heading of "sour stomach" and, indeed, considered as such by many physicians, are assumed to mean excess acid secretion, in some vague way initiated by an ulcer. "Sour stomach," technically called heartburn, pyrosis, and water-brash, does not mean excess gastric acidity, but means usually only that gastric acid, as result of increased gastric tonus, appears in the esophagus above the normal regurgitant zone of $1\frac{1}{2}$ in. cephalad to the cardia. Certainly, more effort should be made to bring about realization on the part of both patient and doctor that sour stomach frequently bears no relationship whatever to the quantity or degree of stomach acidity. All of us are familar with how common it is for patients to be treated for years for peptic ulcer largely on the basis of misinterpretation of what sour stomach actually means physiologically. Not only does such a method of management lead to a lot of useless dosing with alkalies but it is responsible for statistical inaccuracies: the literature and hospital records become filled with diagnoses of peptic ulcers which never have existed and at the same time are lacking in the recognition of those extragastric ailments which are responsible for reflex motor, and perhaps secretory, phenomena on the part of the stomach.

Granting, that by a physiologically correct test meal administered to patients under suitable control, it is possible to secure estimates of acid and peptic secretion in the stomach, it is quite evident that before the results obtained can be considered seriously as indicating digestive activity in the presence of ulcer, one must look at the returns from the standpoint of the status of the ulcer itself. Thinking *pathologically,* becomes necessary before it is possible to say anything about what acid values mean as they are returned from stomachs harboring ulcers. Great series of single specimen analyses or of curves plotted fractionally during a digestive phase have accumulated. What do they mean? Nothing but the accidental secretory capabilities of stomachs at the one occasion when the tests were made. What do pathologic variations in the stages of ulcer

contribute? No accurate evidence is available. Yet from these returns, attempts have been made to say that when ulcer exists in a stomach the acidity or the acid curve is thus and so and the motor cycle is this or that. Certainly, the figures and curves are *correct*, but the difficulty lies in comparing them or in establishing standards indicating what acidity is to be expected when ulcer is present, here or there, or is at an active, progressing stage, or silent. This failure to denote certain facts regarding ulcers vitiates the whole theory of the usefulness of test meal studies. They test nothing.

There are two very important facts which must be known relative to the ulcer at hand before any interpretation can be made of what significance acid and peptic values have. First, I would mention the influence of the pathologic state of the ulcer at the time a test meal study is made. It is scarcely to be expected that the test meal returns will be the same or comparable upon ulcers, pathologically, acute and superficial, large and penetrating, deforming and thick with scar, actively or recently bleeding, actually perforated or undergoing malignant degeneration; yet, a careful survey of the literature fails to record acidity and peptic values described as related to pathologic type of ulcer or its position in the wall of the viscera (stomach or duodenum). Is it any wonder that the whole subject of acidity in its relationship to ulcer exhibits only confusion. Hundreds of capable workers have analyzed thousands of test meals and have attempted to have the results of their analyses indicate how acid secretion in ulcer varies from the normal and yet have never attempted to define just what kind of ulcers, pathologically speaking, they were discussing.

A second factor is concerned with not only the acidity an ulcer exhibits, at its various pathologic stages, but how is acidity affected by the position in the viscus the ulcer occupies. While it is known that fully two-thirds of the ulcers of the stomach lie distal to a line drawn from the right margin of the cardia, to the middle of the greater curvature, yet, sufficient ulcers lie proximal to such a line as to prevent any generalization with respect to acid values in test meals even though the pathologic status of the ulcer is recognized. Anatomically and histologically, it is evident that ulcers located in the receiving and acid secreting segments of the stomach wall, must produce different effects upon the digestive curve than when such ulcers are located in the portions of the stomach devoted to the mixing of food, the liberation of pepsin and the discharge of food from the stomach. Certainly, ulcers located near the cardia or in the fundus of the stomach are capable of producing changes from the normal digestive cycle of a type differing from those ulcers lying in the pars media (with or without hour glass or accessory crater) and from those in the antrum or pylorus where the possibility has to be considered of radically disturbing the emptying time of the stomach, either as the result of pronounced local spasm, perforation with fixation of the part, or organic stenosis accompanied by gastric dilatation and food stagnation. Not until test meal reports are tabulated with respect both to the *pathological status* and the anatomic *position* of the ulcer in the viscus and the mechanical alterations due to ulcer growth, repair or breaking down, can test meal studies be of any significance diagnostically, or as indicating degrees of disturbed physiology or as guides for therapy.

One must frankly admit that most of the work which has been done with test meals for the determination of gastric function in the presence of organic gastric lesion (particularly ulcer and probably also cancer) represents wasted effort. It is time that the figures in the literature and numerous tables were consigned to the scrap-basket and that the work were carried forward along intelligent lines: the employment of a suitable physiologic meal, a meal accepted as standard, a procedure

carried out similarly by all observers and in the tabulation of the results where pathology is present, a grouping of the findings according to the pathology present and to the portion of the viscus in which the pathologic lesion lies.

This discussion has been introduced purposely to emphasize what I mean by the necessity for standards, in research or diagnostic, everyday investigation of alimentary tract disease. Instances where other types of work have not been intelligently done and where the indications are that much of it will have to be done anew, are many. Time permits the listing of but a few. Observations with respect to the presence and significance of occult blood in gastric contents or in the stool must be made and interpreted only in the light of the pathologic status of lesions and by careful physical examination for the source of bleeding in the portion of the alimentary tract suspected of being diseased and only when the contents of the alimentary tract have been controlled with regard to the absence of substances producing positive responses (meats, meal soups, iron-containing foods or medicinal remedies). Further, it would be useful for purposes of statistical study, if a like procedure with a given reagent were employed by various workers. There is no question that test solutions made with the pinkish-gray benzidin powder give sharper reactions and are less subject to error from extraneous causes than are test solutions made with aloin, guaiac, phenolphthalein, etc.

Reports of *x-ray examinations* of the rate of progress of food from the mouth to the external anal ring exhibit many discrepancies in method so that not rarely the interpretation of the results obtained by various workers is most difficult. A fundamental fault with all these roentgen progress meals lies in the fact that the medium in which barium or bismuth is suspended, is itself a food, which is capable of being digested. It follows, therefore, that just so soon as the roentgen meal is taken into the mouth, digestion of the medium suspending the opaque substance begins, with the result that, at least from the stomach distalward, there is left a metallic mass, heavy in proportion to its bulk, which mass does not excite the normal interlocking play of secretion and motility, as does a food, as it travels downward. The progress meals of which we now have roentgen films, merely indicate, in individuals or groups of individuals, how a *similar foreign body* is passed through the alimentary tract. It is readily seen how confusion arises in attempting to appraise the meaning of residues in various viscera or parts of viscera; in fact, one need only study the *same patient* by *several* progress series to appreciate the difficulties of correct interpretation. If the *same individual* exhibits such great variation, then it is not to be wondered at that *groups of individuals* exhibit variations which often prevent any sort of intelligent comparison, diagnostically. What effect upon the progress of roentgen meals through the alimentary canal have absences, deficiencies or increases of digestive secretion, or of disturbances in the correlated neuromuscular activity and tonus, has not been determined.

Other fruitful fields for the establishment of methods which can be called truly *standard*, and which will be carried out by groups of men and from which results that are comparable can be studied, are procedures for testing pancreatic function; the function of the liver (both the excretory and block functions); a uniform method for conducting duodenal drainage of the biliary tract with a formula for interpreting results; a standard diet by which intestinal digestion may be estimated, and results compared; the correct evaluation of the significance etiologically and pathologically of the various alimentary tract protozoa; a mutually understood classification of achylia, and the significance of achlorhydria with or without the employment of histamine; the classification of the forms of colitis, particularly with reference to the significance of constitutional faults;

general or localized abnormalities in the neuromuscular balance or tonus; and the grouping of intestinal flora with the object of establishing which are abnormal or pathogenic and those which are transient or non-pathogenic; the proper technique of proctoscopy and a useful classification of what proctoscopic findings indicate actual visceral disease and those which mean transient, insignificant happening.

One who has had thorough and long-time experience in the investigation of alimentary tract function and contents, all too readily recognizes and admits the limitations which are placed upon our securing accurate or dependable information relative to function, not only in the given subject but in groups of individuals. While variations in the human family will always impose limitations to the securing of absolutely accurate and comparable information regarding digestive activity, there is no reason why if dependable and simple tests and procedures are adopted and routinely carried out, helpful information, and information of comparative worth in the individual and in groups of patients, cannot be obtained. Simplification should be the key word: a few reliable, well-planned, practical test-maneuvers can be made to yield facts, helpful in diagnosing anomalies of digestion and comparable in the appraisal of the anomalies incident to groups of patients.

It is our hope that, before long, a committee can be formed which will pass upon what is useful and what are "frills" and that when this has been accomplished, gastrointestinal invalids can be examined with less discomfort, the results of their test-maneuvers will mean something helpful toward the elucidation of their ailments and reports of their studies will be broadly comparable and hence, instructive.

If this paper contributes anything toward hastening that day, your President will feel that he has served our Association vitally.
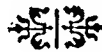
CLASS TEACHING IN PEPTIC ULCER*

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THIS is the story of an earnest effort to improve the treatment of peptic ulcer in the charity patients in the Gastro-Intestinal Clinic of the Boston City Hospital; an improvement to be brought about by the systematic education of the patients in groups. We believe this method is valuable and important and also practical.

We will give our reasons for the need of this education, tell how we have given it and say something about our results with it in the past year.

This paper does not deal with the general subject of the treatment of ulcer, but tells why we use class work and how we do it.

GENERAL CONSIDERATIONS

The idea of a health class is not new. It has been successfully used in tuberculosis, diabetes and other conditions. The idea of education in ulcer is not new. We all need to give it, but we wish to point out that the poorer, less intelligent, hospital patients need education most and are precisely the ones who may not get it owing to lack of time where large groups of patients have to be dealt with in an hour or two. We have had quite satisfactory results with the medical treatment of ulcer in our private patients and have started a campaign of education to try to bring the results in our City Hospital cases up to the same level.

We wish to emphasize the fact that all these patients have individual care first in the wards or out-patient clinic to relieve symptoms and eliminate infections and are then chosen for class work when they are symptom-free, to continue the healing process and to prevent recurrences.

The class is a group of 10 or 12 patients who meet once a week and are taught the nature of the disease, its symptoms, complication and treatment.

The past experience of the clinic has been that many ulcer patients after initial treatment and relief of symptoms report once or twice and then fail to reappear until there is a recurrence of symptoms. We have long felt that the treatment in remissions is a crucial point in treatment which is often neglected. We all know that relief of pain is not a cure. It is usually easy to stop an attack in ulcer cases, to relieve pain, check vomiting, and make the patient comfortable within a short time. Our difficulties often begin when the patient is symptom-free and we still wish to carry out a regular schedule and continue some restriction.

When the diagnosis of ulcer is first made the patient is suffering and often frightened and is very willing to cooperate. Later the fear of the disease wears off when he finds himself promptly relieved and feeling entirely well. Both patient and doctor may get too lax and we have a recurrence. These dangers especially beset the hospital patient or less intelligent patient through ignorance or carelessness. This sort of thing is the bane of medical treatment which should be well ordered and progressive like that of diabetes. The symptom-free ulcer patient like the sugar-free diabetic is in a happy condition which must be continued at some sacrifice.

We have tried to combat the things which favor recurrence by a simple practical education. We believe that the patients who know the most, other things being equal, will live the longest and are most likely to avoid later illness and operation. We believe that the patients should not merely receive a diet list and some prescriptions. They should be taught the principles of the treatment of ulcer, its aim, nature, and the duration, and also its good results.

We outline the conditions which start

the disease and cause recurrence, the importance of infection, of nervous upsets, of wrong food, excess of tobacco, etc. We emphasize the conditions which promote healing and the necessity for playing the long game and not mistaking an intermission for a cure. We point out the cost of illness as an incentive to health and the prevention of recurrences.

In addition to knowledge the ulcer patient like the diabetic must have character in order to succeed and may need to be taught self-control and the willingness to make sacrifices for a good cause. We show that persons with quite severe symptoms or complications such as previous perforation or hemorrhage or obstruction of the pylorus, if they are honest and sensible and have reasonable self-control, may maintain health and comfort and keep steadily at work.

In emphasizing the importance of follow-up treatment, we often say that *ulcer cases are not cured in the hospital wards*. The patient goes into the hospital because of a complication or because he is not doing well on ambulatory treatment. The complication is relieved, the symptoms disappear, but the disease remains, and complete healing follows slowly and must be watched over for a long time.

THE REASON FOR CLASS WORK

Class work in ulcer, like other health classes, has seemed very useful for the following reasons: There is a great saving of time and effort. We avoid saying the same thing so many times to different persons and can take more time to explain in detail the reasons for our treatment. The patients learn from one another by questions and answers. The force of example is important. The more intelligent patients stimulate the others and develop an esprit de corps, a real competition in keeping well.

We have thought of the possibility of developing neurasthenia by so much talk about illness or of making some patients nervous by rehearsing the grim possi-

bilities of ulcer; but in general we have found that the more the patients know about ulcer the less frightened they are and the more ready to follow the treatment.

The class is a course in treatment and in order to graduate the patient should know what kind of a diet is best, why frequent feedings are used, what drugs are most useful and why, how long it usually takes to heal an ulcer, and what leads to recurrences.

THE CLASS

The patients in our classes are practically all symptom-free. All types of ulcer are included. About two-thirds come from other out-patient departments of the hospital. This group includes the milder ones of shorter duration and showing less complications. About one-third come from the hospital wards, mostly from the medical side after several weeks stay in the hospital usually on a modified Sippy diet, including post-hemorrhage cases.

There is also a small but constantly increasing number of surgical cases after operation for perforation, pyloric obstruction, or repeated hemorrhage, or with recurrent symptoms after operation. The surgeons at present have not taken full advantage of their opportunities to send postoperative cases to the clinic for a careful follow-up. These postoperative cases are among the most faithful of our class, probably because they realize the seriousness of ulcer.

The patients from the wards are also quite a faithful group. They have learned that an ulcer may lay them up for periods of several weeks or more. The out-patient cases are the most likely to drift away as soon as they become symptom-free.

The vast majority are males of the wage-earning class and age. In a cosmopolitan city they are of all nationalities and of various grades of mental development.

They meet in small intimate classes of ten once a week for eight weeks for a twenty-minute informal talk by the doctor followed by ten minutes of open discussion

by members of the class. The list of talks is given below. Each time the following questionnaire is given to each member of the group which enables us to follow his progress.

Name   Date
Weight today   Weight last week
Pain   If present, what relation to meal
   How   relieved   Any   change   in   character
Heart   burn   Vomiting   Bowel   movement, color
Are you taking powders?   How often?
What diet are you on?   Do you live   up to it?
Any other complaints   If yes, what?

If any digestive symptoms arise, the patient is referred back to the clinic for individual care. Any non-digestive symptoms are taken care of by the proper department. All patients after the class work report back to the Gastro-Intestinal Clinic for the usual follow-up.

SUBJECTS DISCUSSED DURING THE CLASS

What is an ulcer. Location of ulcers. Importance of knowing the location of ulcer (malignant degeneration of gastric ulcers). Multiple ulcers. Anatomy and physiology of stomach and duodenum.

Etiology of ulcer: Foci of infection, hyperacidity, tobacco.

Symptoms of ulcer: Chronicity, periodicity. Remissions do not denote cure. Heartburn, pain, food and soda relief. Recurrence and new ulcer. Vomiting, suspicious of pyloric obstruction. Hematemesis and tarry stools. Perforation and its danger.

Diagnosis: Symptoms, physical examination, x-ray, stomach contents and stools.

Treatment: Hospital versus ambulatory.

Ambulatory Treatment: Education, graded diet, no tobacco or alcohol, removal of foci of infection, alkalies, belladonna or atropine.

Surgical treatment for complications or suspicion of cancer must be followed by diet and medical management.

The ultimate cure depends upon the patient and his cooperation.

SUBJECT MATTER FOR TALKS

There are many valuable points in the treatment of ulcer which can be simply presented to a lay class such as the following:

Diet: A detailed discussion of simple foods, bland food, irritating foods, roughage, acid foods, those which stay long in the stomach; why some are used and others not. The dangers of experimenting with forbidden food and of breaking training at the suggestion of friends or family. Frequent feeding and the reason for it. The importance of a regular schedule, six or more feedings a day; how to manage it when at work. Proper methods of eating, slow thorough chewing, the necessity of plenty of good clean teeth.

Food values: Limitation of diet is not starvation or "weakening." Patients often gain weight if their work is not too heavy. Milk, cream, butter, egg, cereals, bread are very nutritious. Many of the low value foods are left out such as raw greens and fruit, broths, etc. The fallacy of meat being a "strong food." Compare lean beef at 800 calories per pound with cereal at 1600 calories per pound.

The cost of the ulcer diet is not above the average. Milk, egg, cereals, and bread are used freely and expensive meat, raw greens, and fruit left in the background.

Vitamines, their importance, where found, and how much are needed. Salt and condiments. The effect of alcohol on the stomach.

It takes some skill and care to live contentedly and successfully on an ulcer diet for the first six months.

Hygiene: The effect of rush, strain, anger, worry, etc.; the benefits of rest, sleep, outdoor life, fun, vacation. Physical exercise, the kind and when to take it; heavy jobs, gymnasium work, athletic contests. Care of the teeth, their importance for proper chewing, infection. The effect of tobacco on the stomach. Change in

body weight which occurs during treatment. Care of the bowels; constipation on the bland diet and how to avoid it; the use of magnesia, mineral oil or irritating laxative.

Drugs: Alkaline powders and tablets. How to mix cheap Sippy powders at home. Belladonna.

The Complications of Ulcer: How to recognize bleeding. What to do first. The seriousness of perforation, the importance of early operation. Early treatment of any recurrent symptoms.

Surgery: Its value and limitations. How to avoid it. Surgery is only for complications or for failure of medical treatment. The need of follow-up treatment after surgery.

RESULTS

The classes are well attended. Seven out of ten attend every session although they have a job and the classes are during working hours. One or two may drop out after the first or second session and there are one or two tardy ones. The more intelligent members of the various groups have clearly shown that they highly appreciate the class work and recognize its value. There is a certain esprit de corps developed in each group, a friendly rivalry in good health, and when they go back to the various sections of the community, they become to a certain extent missionaries of better health and food habits.

As the number of out groups increases, we may have reunions at three or six months' intervals in order to keep in touch with them for years instead of weeks or months. In larger clinics possibly, it would be wise to make different kinds of groups; simple ulcers, bleeding cases, postoperative cases, etc., and to vary the talks accordingly. We have not done this.

In our class work we find the force of example very useful. Some patients are more conscientious than others and stimulate and encourage the latter to "play the game." Some of the less intelligent patients who make unconscious mistakes

in diet are sometimes laughed at by the others and thus shamed into taking better care of themselves. Many points about food are brought out in the discussions which saves much repetition and loss of time. All the patients get more accurate and detailed instruction about foods. It is customary in our clinic and probably in most others to give the patient a printed sheet telling which foods are allowed and which prohibited, which he must then interpret and apply to the best of his ability. The result is sometimes a one-sided diet, sometimes diet deficiencies which slow the healing of the ulcer. The members of our class have their diets analyzed and explained in detail. The dangers of low vitamines for a long period of time are shown and simple ways to avoid deficiency diseases are given. At the end of a short period of talks, the patient knows much more about his diet and treatment and is much more willing to follow it.

It is very encouraging to see patients who were indifferent to the removal of various foci of infection come forward and request that infected teeth be treated or removed, or that tonsils be removed, or say that they are now ready for a needed operation on an antrum which they had previously refused.

It is instructive in the discussion period to find out what the ulcer patients are thinking about. Their first and foremost question is: When is an ulcer healed and how can we tell the time? The next most frequent question is about diet, the safety of taking certain foods of all kinds. The importance of frequent feeding and the ways and means of carrying it out in various trades and occupations comes in for a great deal of discussion. The dangers and frequency of malignant degeneration of ulcer seems to have made a deep impression on the lay mind. The size of an ulcer and the number of ulcers in an individual case is frequently discussed. The failure of a surgeon to tell his patient the importance of postoperative diet and follow-up is often criticized, especially by the postoperative

patients who have had recurrences. Other questions are: What is the best procedure if a patient should have a second hemorrhage? Is a recurrence of symptoms due to a new ulcer or an old ulcer? What is the value of the roentgen ray in diagnosing an ulcer and proving its cure, etc?

The physician who leads the class also learns something. In addition to finding out what the patients are thinking about, he trains himself to present the subject of ulcer in a popular manner and also gets an opportunity to watch a group of cases for a long period.

The results of our class work have been for the physicians closer contact with the symptom-free ulcer patients and a better understanding of their points of view, and for the patients clearer and better ideas derived from discussion of the many practical ulcer problems, and better cooperation which we believe will lead to better end-results.

DISCUSSION

DR. LICHTY: I think this is a very important paper, and one which should be given careful consideration. It seems to me that, too often, in cases of this kind, the great object of the doctor is to hurry his patient through and get him to the surgeon, and, theoretically "cured," without stopping to think of what can be done for him medically. He is not interested in those small, trivial things, which mean so much to the patient at that time, and which will, perhaps, mean a great deal more to him, later on. I believe that the benefit to be derived by the patients is very great, and further, you can help the interns, or residents, because they will have a better chance to observe these cases. In most clinics, you are usually dealing largely with end-results. Prophylaxis is not given the attention which is due the patient suffering from the early symptoms of digestive disturbances. Some of the disasters often met by the peptic ulcer patient are altogether too prevalent.

DR. SMITHIES: This scheme was carried out at Chicago, in the Augustana Hospital, before the War, and I believe Dr. White visited my clinic then. It worked very nicely. We had a Sunday morning class, and got a good attendance. We found that many of these patients had a wide variety of ideas on the question of ulceration, its cause, and its cure, and consequences. We tried to educate them in a rational manner. There was a certain amount of danger in some of this work, of developing in these cases, a sort of cancerphobia. Patients were apt, if one did not watch them, to come to associate ulcer with cancer. When we could impress upon them the fact that, if a duodenal ulcer existed, and not a gastric ulcer, they would rarely have cancer and that only about 4 or 5 per cent of gastric ulcers might possibly result in cancer we felt that we had accomplished a big thing. However when that assurance was driven home many patients got quite careless and paid relatively little attention to their habits in the comfortable phases of their ulcer life. One of our most difficult tasks was to talk positively, because we, ourselves were too conscious of the many things not known about ulcer.

NEW INCISION FOR OPERATIONS UPON THE URINARY BLADDER*

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NEW YORK

INTRODUCTION

OUR attention was called to the advantages of a transverse incision in the operation of suprapubic cystostomy by Dr. B. W. Wright of Los Angeles in his discussion of one of the papers at the last meeting of the American Urological Association in Seattle, Wash. His description of MacGowan's method so impressed us that we utilized this method upon the very first patient operated upon after our return from the meeting.

The exposure was so much superior to the ordinary midline incision that we became interested immediately and modified it to suit our needs.

LITERATURE

The employment of a transverse incision for exposure of the bladder seems to have originated in Trendelenburg's Clinic at Bonn, sometime during the last quarter of the 19th century. The method was described at length by Eigenbrodt in 1888[1] and by Trendelenburg himself in an article published in 1890.[2] The use of this incision seems to have been limited largely to gynecological work, and it was applied to female patients suffering from vesical growths rather as an extension of the technique to operations upon the genital tract in women. Stoeckel[3] advocates an exposure of vesical growths in the female which embodies most of the features of Trendelenburg's method, including the transverse incision. In the first edition of his "Operative Gynecology" (1898) Howard Kelly mentions the possibility of using the transverse incision for removing bladder growths, but deprecates it because of the increased difficulty of closing such a wound, although acknowledging the ad-

vantages of the greater space and vision it affords. Seventeen years later, his opinion of this incision seems to have risen, for in another book[4] which he wrote in conjunction with Burnam in 1914, four pages, with elaborate illustrations, are devoted to bladder exposure by transverse suprapubic incision.

The paper written by Granville Mac-Gowan[5] was probably produced at the same period when Kelly and Burnam were at work upon their book. MacGowan specifically disclaimed any originality in his use of the transverse incision, but added that he had never encountered any description of the precise procedure for suprapubic cystotomy which he was describing. Certainly it would appear that he was among the first to apply this incision as a routine outside the limits of the gynecological field.

According to Eigenbrodt, Trendelenburg first employed the customary median incision when dealing with vesical calculus or other pathologic conditions in the bladder which required operation. Later the advantages of the transverse incision above the symphysis became more apparent. The transverse incision was suggested by two calculus cases both the subjects of operation being fat with pendulous abdomens. The transverse incision proved very successful, inasmuch as the prevesical peritoneum could be avoided with more ease and certainty, and a far better view of the vesical cavity was to be had. Drainage was available at each end, and the gaping incision could be reduced to controllable size by use of properly placed lateral sutures. The technique was as follows: After the skin and cutaneous fat are divided, the muscle tissue being exposed, muscle and fascia being divided as close as

* From the Department of Urology (James Buchanan Brady Foundation) of the New York Hospital.
Read before the Genito-Urinary Section of the New York Academy of Medicine, May 21, 1930.

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possible to their insertion, the index finger of the left hand is pressed against the recti and the knife carried close to the superior and posterior surface of the symphysis. Tendons and fascia are easily parted, exposing the prevesical fat. By blunt dissection the overlying structures are freed from the bladder, and lifted backward and upward care being taken to avoid the prevesical fold of peritoneum. The incision through the skin and fascia may be anywhere from 3 to 8 cm. in length, according to the nature and purpose of the bladder intervention.

MacGowan's procedure differs from the preceding principally in his method of staying the wound as soon as sufficient exposure of the bladder has been accomplished. He prefers to incise the bladder wall longitudinally, though stating that a transverse or longitudinal incision may be used. As soon as the bladder is opened as widely as desired, 2 to 4 sutures are to be inserted through all its coats and muscle and fascia on each side, so that the space in front of the bladder and between it and the pubic bones shall not be disturbed by subsequent manipulations. If two of these stitches are placed in front, one on each side of the median line, and the bladder is held up by two other lateral stitches, it is kept during the whole course of the operation in such relation to its surroundings that they do not become infected.

Examination of the literature of bladder surgery which has appeared since MacGowan's publication does not produce evidence of especial interest in the advantages offered by the transverse approach. A number of operators appear to have used it in resecting diverticula, and it is mentioned quite frequently in relation to gynecological procedures; but in most reports on bladder surgery, if the type of incision is mentioned at all, it will prove to have been the usual one in the midline. To be sure, the fifth volume of Bickham's "Operative Surgery,"[6] contains an extended description of transverse suprapubic cystotomy according to the method

of Pfannenstiel. Pfannenstiel's curved suprapubic incision was, however, first introduced as an adjunct to Cesarean section, and is still primarily so employed. The procedure advocated by Bickham divides not only the skin and fascia by a transversely curved incision, but the abdominal aponeuroses and muscles by a straight transverse incision, and finally the bladder wall itself is opened transversely. The statement is made that this incision is suitable only when the very freest access must be obtained, as in the presence of very large tumors. Against the ease of approach must be weighed the damage apt to result from transverse division of the abdominal wall.

OUR TECHNIQUE

It is our impression that it is most important to have the drainage tube inserted into the highest possible point of the vesical fundus and that the course of the fistula remaining after removal of the drainage tube should be obliquely upward to the highest possible point in the skin incision. This position will aid materially in the rapid closing of the wound because the pressure of abdominal contents upon the oblique passage will aid in its closure by mechanical pressure.

An important consideration lies in the fact that if the fistula and its resulting scar are high and subsequent operation is necessary the peritoneum is held well up out of harm's way and the second incision below this point is unattended with the danger of penetrating the peritoneum.

With these facts in mind we decided that the most suitable incision was an inverted v incision, the apex of which should be well above the point to which the dome of the distended bladder would reach. It is therefore our practice in doing an ordinary suprapubic cystostomy to incise with the apex of the inverted v at a point about three-fourths of the distance between the symphysis pubis and umbilicus.

The incision is deepened through the skin and subcutaneous tissue, the sheath

of the recti on each side is incised and if the recti are firm, strong muscles they are cut across either partially or entirely as directly to the highest point of the vesical fundus.

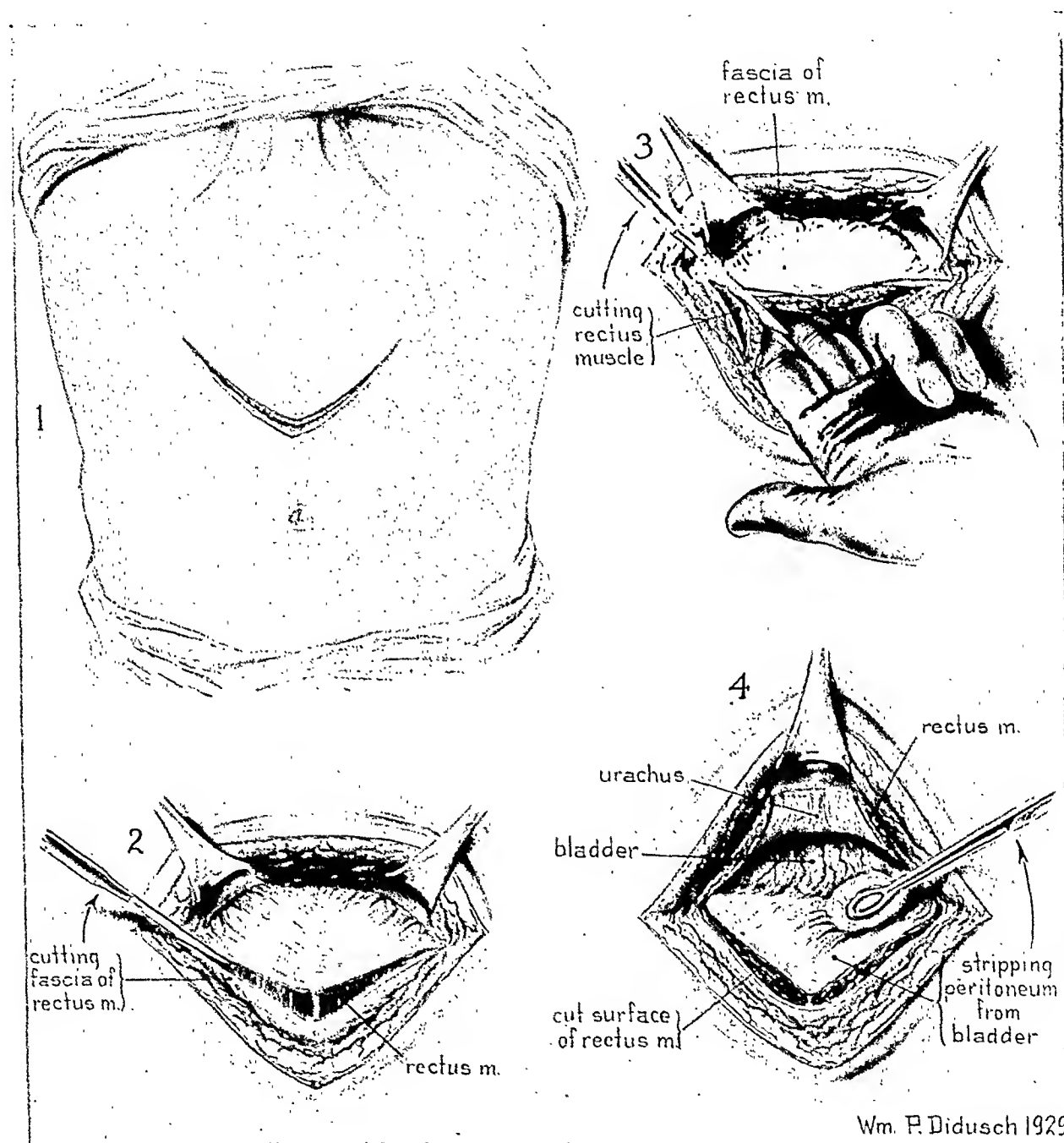By careful blunt dissection the peri-

Fig. 1.

1. Location and shape of usual inverted V incision for bladder operations.
2. Incision is deepened through fascia of rectus muscle on each side.
3. Muscle itself may be cut through as in this illustration or separated and retracted as deemed necessary.
4. Urachus is followed down until it reaches top of bladder; then dissection is carried back, exposing vault of that viscus, by pushing back the peritoneum. Care is taken not to penetrate the space of Retzius.

the case may demand. The obliterated hypogastric vessels and the urachus are encountered and by dissecting along the latter structure, with care, one is led toneum may be easily separated from the bladder wall without approaching, even, the space of Retzius. On account of the fact that there is no excavation necessary
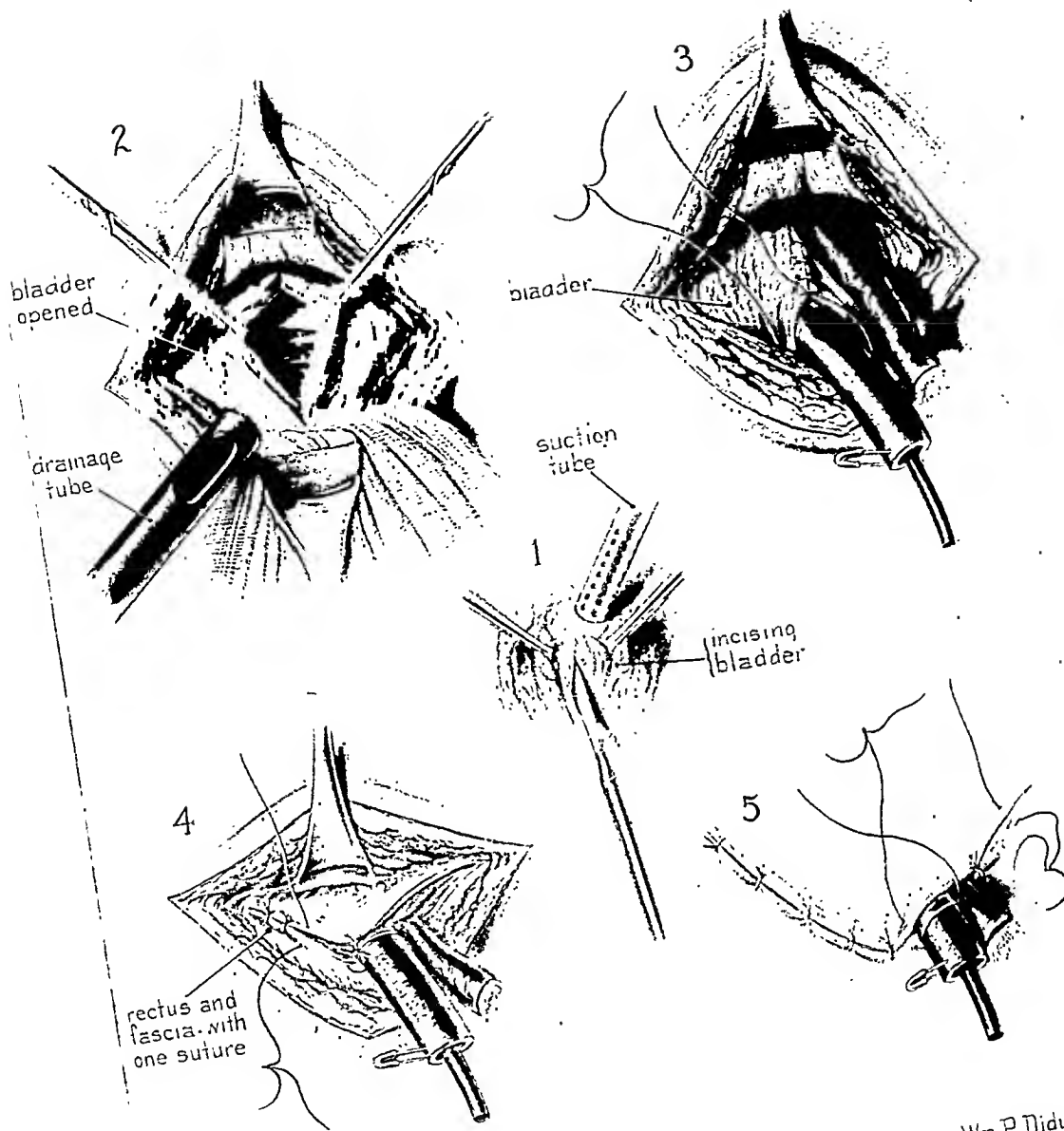
Wm. P. Didusch 1929.

FIG. 2.

1. Wall of bladder is grasped with Allis clamps, incised and fluid remaining in that viscus is carried away by a suction tube.

2. Bladder wall is incised to desired length and if it is a case of excision of tumor, diverticulum or any other operative procedure this is accomplished.

3. Kenyon double suction tube is then fixed at highest point of bladder incision by a catgut suture tied around it and sutured at apex of V. Cigarette drain is fixed in position over line of incision.

4. Layers of muscle and fascia are replaced with plain catgut.

5. Skin is sutured with silkworm gut and Kenyon tube fixed with one suture. By fixing tube at bladder and skin the dead space is eliminated and tube is brought through abdominal wall obliquely.

behind the symphysis pubis we have not found it necessary to stitch the bladder to the rectus as MacGowan and his followers do. This is due to the high incision which we employ.

The bladder, having been exposed as herein described and recognized by the richness of its blood supply and its muscle fibers, is then grasped by Allis clamps incised between them and its contents removed by a suction apparatus. A double suction tube is then fixed at the highest point in the vesical incision with plain catgut and then sutured to the apex of the incision through the fascia. This establishes an oblique passage through the abdominal wall for the drainage tube and its succeeding fistula. A small cigarette drain is inserted along the suture line of the bladder.

The fibers of the recti are approximated with plain interrupted catgut stitches and the fascial coverings of the recti are sutured with continuous plain catgut. The skin is closed in the usual manner with interrupted silkworm gut sutures one of which is tied around the double suction tube fixing its position at the surface.

In cases requiring more efficient exposure of the bladder such as resection of vesical neoplasm with transplantation of the ureter or resection of vesical diverticula it is found useful to make the incision midway between the umbilicus and symphysis. In this manner the entire pelvis is laid open and the exposure is very much superior to any that the author has used or seen. In fact even the most difficult operations in the pelvis are rendered infinitely more simple by utilizing this incision.

CITATION OF CASES

There were 45 consecutive cases of patients studied in this series; the youngest was twenty-four years of age, the oldest eighty-four years, the average age being 57.46 years.

Of these patients 30 were operated upon for the purpose of establishing suprapubic drainage as a preliminary to prostatectomy, 10 were subjected to resection of vesical tumors. Large vesical calculi were removed from 2.

There were 2 plastic operations upon the lower end of the ureters and 1 had a vesical diverticulum.

The type of drainage employed following this operation was the Kenyon double suction tube in 34 cases; gravity was employed in 9 cases and urethral catheter drainage in 2 cases.

Healing of the suprapubic wound occurred without infection in 39 cases. In 5 cases there was a transient infection lasting a few days only and in 1 case this was extended to ten days. In no case was there extensive infection and nothing resembling the old fashioned pelvic cellulitis was encountered at all.

After removal of the suprapubic tube the closing of the fistula occurred much more rapidly than in any of the other methods tried by us. The quickest closing was in three days, the large majority were healed in ten days and the remainder before the eighteenth day with one exception and this one required fifty-three days. The average for all of the cases was 11.9 days.

SUMMARY OF RESULTS

The most satisfying fact in the employment of this new modification of an old incision is in the marvelous exposure obtained for operations upon the urinary bladder. In cases requiring wide dissection of the vesical fundus it is indispensable.

In one case (T. C.) in which there were stones in the lower ends of both ureters, too large to pass, and upon which plastic operations were done this exposure was entirely satisfactory.

In doing a two-stage suprapubic prostatectomy the inverted v incision is practiced for the first operation and at the second a linear incision may be extended from the fistulous tract down to the symphysis pubis through virgin tissue which gives much more room than can be ordinarily obtained and makes proper visualization of the prostatic bed possible by allowing retraction of the tissues.

The fact that in this procedure there is no entrance into the space of Retzius prevents pelvic cellulitus and is an additional advantage resulting from this type of suprapubic operation upon the urinary bladder.

When utilized in cases of diverticulectomy, resection of wide areas of vesical tissue, with or without transplantation of the ureter, this type of incision gives such a splendid visualization of the pelvic structures that it seems to us to be indispensable.

CONCLUSIONS

1. This operation is easily accomplished under regional anesthesia.

2. The inverted v allows the drainage tube to be placed high in the fundus of the bladder and high in the skin wound, to course obliquely through the abdominal wall. This makes for rapidly healing fistulae.

3. In case a secondary operation is to be performed the incision may extend from the fistulous tract to the symphysis through virgin tissue without fear of injuring the peritoneum.

4. The danger of pelvic cellulitis is eliminated because the space of Retzius is not opened.

5. In this series of 45 cases there have been only 6 cases of infection of the suprapubic wound; all others have healed by primary intention. The average time required for the suprapubic fistula to close was 11.9 days.

6. The view obtained by the utilization of this incision is so satisfactory that the most extensive vesical resections and plastic operations upon the lower ends of the ureters are rendered infinitely easier for the operator as compared with the usual approach.

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ELECTROSURGERY IN THE TREATMENT OF CANCER*

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WHEN the nature of tumor growth was but little understood, mechanical removal with caustic, cautery or knife represented the most efficient therapeutic procedure. Variations in the course of the disease were recognized clinically but these differences were not correlated with the underlying pathological process. Neither successes nor failures could be explained upon a sound or logical basis. For many generations the treatment of cancer remained entirely empirical.

Within the past few years, however, experimental evidence in the field of transplantable tumors has yielded new information and as our knowledge of the disease has increased so our treatment has become more complex. As microscopical investigations have unfolded important pathological data there has been developed a more intimate correlation between the pathological and clinical phases of cancer which has led to a more rational scheme of therapy.

More recently research has thrown considerable light on cancer as a process. Thus Cramer,[1] of the Imperial Cancer Research Laboratories, reports a series of experiments which may prove to be of the highest importance. Cramer has shown that if a large area of the skin of a mouse is subjected to chronic irritation by tar-painting the development of malignant growth is confined to a very small portion of that area. If papillomata have developed in the area together with the malignant growth, they retain their benign character. If, after the removal of the malignant growth, the area of skin in which no malignant development has taken place is preserved, it is found that in that area malignant growth may develop again in a new center, either beginning at the base of a papilloma which was left behind or starting as an entirely new growth. Removal of the second malignant tumor has sometimes been followed by the development of a third malignant growth. In further experiments in which irritation was applied directly to the base of a papilloma immediate malignant development was observed in six animals.

Cramer concludes that these observations supply evidence that the development of a carcinoma is not entirely dependent upon changes in the epithelial cells but that there are local inhibitory factors capable of keeping the malignant development in check and that the immediate cause of the genesis of a carcinoma may be the removal of a local inhibition residing in tissue elements other than epithelial cells. The process of carcinogenesis is therefore not a continuous one but is composed of two phases: a process of long duration which induces a state of "potential malignancy" kept in check by a local resistance and, secondly, a local breaking down of this resistance which allows of an immediate malignant development of the "potentially malignant" cells.

The earliest stages of human cancer have been shown by Sir Lenthal Cheatle[2] in his sections of whole breasts. Cheatle has been able to demonstrate that the epithelial cells lining the ducts and acini of the breast undergo normal desquamation and that the first stage in the cancer process is the formation of papillomata. This benign papillomatous stage is followed by a stage in which the epithelial cells are atypical but confined within their normal boundaries; the third and final stage is the development of carcinoma. These three stages in the development of carcinoma in the human are comparable to the production of tar cancer in mice. A

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similar sequence of events has been demonstrated in the production of rectal carcinoma by Cuthbert-Dukes.[3] From these researches it would appear that carcinoma is a process that begins usually as a benign epithelial proliferation and ends, if the process continues, in the formation of a malignant tumor.

Advances in the study of cancer have been accompanied by important developments in the clinical and pathological phases of the disease. An important step forward was taken with the introduction and the progress toward perfecting the application of roentgen rays and radium. The development of radiation in the treatment of cancer has, in addition to its therapeutic value, yielded important information in regard to the biology of tumor growth. Comparison of histologic structure of tumors and their response to radiation has reached a stage where it is now possible, in most instances, to predict from histological examination of the tumor the response it may be expected to make to radiation.

Pathologists for many years have been seeking to determine the degree of malignancy of tumors from the histologic structure and Broders[4] has found that a definite relationship does exist between degree of differentiation and prognosis under surgical treatment. His conclusions have been confirmed by Martzloff,[5,6] Greenough[7] and others and although some pathologists have disputed the value of the method it appears that their criticism is based upon isolated exceptions to the rule. My own clinical experience has led me to believe that knowledge of the histologic structure of a tumor may be of great practical value in determining the proper form of therapy.

The law of Bergonié and Thibaudeau that the less differentiated a tumor the more radiosensitive it is has had clinical confirmation in the report of Healy and Cutler[8] who, investigating 200 cases of carcinoma of the cervix, were able to demonstrate that the anaplastic group, with the worst prognosis under surgical measures, offered the best prognosis under adequate radiation therapy. The reason for this is the marked radiosensitivity of the undifferentiated, anaplastic cells.

Failure to appreciate the effects of the histologic structure on prognosis has led in the past and must lead in the future to misconceptions and erroneous deductions, resulting in the issuance of statistics of little scientific value. In a recent editorial in *Surgery, Gynecology and Obstetrics* Dr. W. J. Mayo emphasizes the importance of the microscopic study of malignant lesions as a basis for treatment. He confirms the view that a lesion of the most malignant grade which does not offer sufficient hope of cure to justify surgical measures may be susceptible to radiotherapy or heat. To arrive at the definite knowledge of the nature of the lesion, which alone enables us to prescribe treatment scientifically, Dr. Mayo commends the frozen section of fresh tissue which can be prepared rapidly, that is, in time to be of benefit to the patient, and he adds that "fresh frozen section has come into its own."

Scalpel incision of healthy, intact tissues for the removal of biopsies is conceded to be accompanied by a certain element of danger, the danger being lessened when the lesion is ulcerated. Since the advent of the endotherm knife,[9] or cutting current, the removal of tissue for biopsy is no longer looked upon as a hazardous procedure.

With the biopsy electrode a small fragment of tissue may be excised with the greatest facility and safety. The sealing of lymphatics and the elimination of trauma are the two important advantages of the new method. The crushing of the minute specimen which accompanies the use of forceps is eliminated so that it is now possible with the rapid frozen section method to have specimens taken, frozen, cut and stained within a very few minutes. In most cases this can be carried out as an office routine except in tissues too friable for freezing, when a rapid paraffin section

must be resorted to. I have followed this office procedure in a series of cases and have found it consistently certain, rapid and helpful. It must be borne in mind, however, that a negative biopsy does not exclude the possibility of the presence of malignant disease.

A formidable difficulty that arises in the evaluation of different methods of treatment is due to the extreme variations in the natural course of untreated malignant disease. Certain untreated cancers may run a course of many years. Daland[10] has shown in his report of 100 cases of untreated breast cancer an average life of 3⅓ years.

Factors that determine the results of treatment in any given case of malignant disease are multiple but the most important are:

(1) The extent of the disease,

(2) The degree of malignancy of the tumor,

(3) The radiosensitivity of the lesion,

(4) Accessibility to treatment and general condition of the patient.

Frequently a patient suffering from an extensive malignant growth has remained in good general condition. Such a patient, though considered surgically inoperable, offers a fair prognosis if properly treated.

The extent of the disease may limit or prohibit the procedure of scalpel surgery but two new methods now available offer considerable hope in advanced cases which would otherwise be regarded as hopeless. When an advanced lesion is radiosensitive irradiation may yield definite palliation and in many instances surprisingly good results are observed. Furthermore, it cannot be doubted that irradiation of highly malignant lesions (grades III and IV of Broders) by destroying the most radiosensitive elements renders the lesion more susceptible to treatment by electrosurgery.

On the other hand, when a lesion is both advanced and radioresistant neither scalpel nor radiation has much to offer. To this rather large group of cases electrosurgery or endothermy is peculiarly adapted. Through the surgical application of endogenous heat it is possible to destroy and remove extensive lesions with a degree of protection not provided by any other agent. Particularly in the treatment of those radioresistant lesions that are notoriously prone to recur after scalpel excision, such as squamous carcinoma, neurogenic sarcoma and melanoma has endothermy won for itself a unique place. Not alone in advanced radioresistant lesions should endothermy be held a dependable adjunct but its merits render it yet more dependable in the treatment of beginning cancer and precancerous lesions. Too often is this method fallaciously regarded only as a means of last resort.

The profession is familiar with the reasons for the failure of scalpel surgery in many malignant lesions. We know that metastases and recurrences following scalpel interference do not just *happen;* they follow logically, scientifically.

In a brilliantly informing article on "The Relative Values of Surgery and Radiotherapy," Dr. Mayo[11] pointed out that only particles of molecular size such as the amino-acids, sugar and other crystalloids are absorbed directly through the vascular capillaries, while colloids and large particles are picked up by the lymphatics. This makes clear the threat of transplantation which lies in the scalpel's severance of lymphatics and demonstrates the advantages of incision by the cutting current which sterilizes and seals lymphatics as it cuts.

This quality of protection against mechanical implantation of malignant cells is inherent in a proper technique of endothermy whereby we have two distinct procedures: first, to excise the lesion with the endotherm knife or cutting current and, second, to destroy the lesion in situ first by desiccation or coagulation and then immediately to remove it as dead tissue instead of as viable cells.

The lightest current, the monopolar, which dehydrates the area to which it is applied, was perfected by Dr. W. L.

Clark[12] of Philadelphia who found that there is a point between hyperemia and incineration which may be reached and sustained in the treatment of tissue. He calls this the desiccation point. Its use is indicated in small, superficial, localized lesions which are accessible or may be made accessible by the endotherm knife. There is possible the greatest delicacy of its application which assures a soft, pliable scar free of fibrosis and telangiectasis. The range of its usefulness is very great.

The second current, the bipolar or coagulating, is the current which has been most used and over the longest period of years. A malignant lesion which is coagulated is a destroyed lesion. Sterilizing and sealing of lymphatics minimize the likelihood of metastasis and recurrence; capping of afferent, sensory nerve endings diminishes surgical shock; decreasing hemorrhage by sealing smaller blood vessels, all these benefits follow the use of each of the currents. The third current, the endotherm knife, is most recent in point of perfection and use, having been presented by the writer before the New York State Medical Society only in 1924.

Endothermy can be used in repeated treatments without prejudice to the patient but the lesion treated should be destroyed and removed in a single operation. There is no injury to the surrounding tissues for the reason that endothermy is at all times under the control of the operator to administer just as much or just as little as his experience has taught him is proper. A subsequent nodule or induration may be destroyed and removed on precisely the same terms as the first lesion, if endothermy is the remedial agent.

Malignant growths in cavities such as the antrum, larynx, bladder, etc., may be made accessible by incising with the endotherm knife and then desiccated or coagulated as may be indicated. Schmiegelow of Copenhagen has reported exceptional results in treatment of tumors of the larynx and Beer's success in the treatment of bladder tumors is well known. Cushing of Boston reports splendid results with the monopolar and the cutting currents in the treatment of tumors of the brain. From Kelly of Baltimore have come interesting reports of the value of electrosurgery in abdominal conditions. Berven of the Radiumhemmet in Stockholm is treating carcinoma of the vulva exclusively with endothermy; Holmgren of the same institute is handling his cases of carcinoma of the antrum with endothermy alone or in combination with external radiation. Blumenthal of the Charité Hospital in Berlin is removing primary operable carcinoma of the breast by the cutting current with subsequent radiation. Sampson-Handley of London in a recent report concludes: "For the past year I have operated upon most of my cases of breast cancer by the electric needle instead of the knife . . . The method presents great and appealing advantages."

Thus is the weight of the evidence increased and although at first the obvious benefits of treating malignant lesions by electrosurgery surprised and delighted both operator and patient, the experience of many years has shown that results here, as elsewhere in this law-governed universe, move logically from cause to effect.

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CUTANEOUS BURNS AND SCALDS*

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PRIMARILY, the seriousness of cutaneous burns and scalds (except those caused by radium and x-rays) depends on the extent, depth and location of the injury. Internal pathology, in its recognizable manifestations, may become of paramount importance; but this is later, and usually is predictable from the external damage.

It is generally recognized that the extent of the burned surface is of greater prognostic importance than its depth. The nature of these important injuries is such, however, that descriptive classification is impossible, even, or especially, when exact direct measurements are available. Hence the old view prevailed until recently, that this is "a matter which necessarily eludes formal classification."[1]

But, and this has not been noted sufficiently, chief prognostic importance does not rest with the size of the burned area per se. Healing-time does largely depend upon the amount of injured surface: *Recovery depends upon the relative amount of uninjured and functioning surface which remains.* For example, a first and second degree burn totaling 5000 sq. cm. in a child having a total body surface 10,000 sq. cm. would prove fatal; but in a man having a total body surface of 20,000 sq. cm., the same extent and depth of involvement would be of far less serious import.

In 1924 I[2] pointed out that from a knowledge of surface-area proportions of the head, the trunk, and the upper and lower extremities and their natural subdivisions, the extensiveness of cutaneous lesions could be estimated and stated in *percentage.* For example, having established that the head area is 6.5 per cent of the total body surface, a burn involving one-half of the head must be a 3.25 per cent

burn. Whenever burns involve several parts of the body, the involvement of each part can be estimated separately and the sum of these involvements is the total per cent burned.

By a slight alteration of the true surface-area proportions, the factor of the location of the injury as it affects prognosis can be included in the single numerical expression, under per cent of body burned. By giving to the trunk the decimal percentages of the other parts, the proportions are adjusted to the greater seriousness of burns of the chest, abdomen and perineal region. At the same time the figures are simplified. The proportions to be remembered are: head, 6 per cent; upper extremities, 18 per cent; trunk, 38 per cent; lower extremities, 38 per cent. The neck is included with the head, the genitals with the trunk, and the buttocks with the thighs. Of the lower extremities, the feet are $\frac{1}{6}$, the legs $\frac{1}{3}$ $(\frac{2}{6})$, the thighs $\frac{1}{2}$ $(\frac{3}{6})$.

It should be remembered that the altered proportions are not the true surface-area proportions of the body parts. For that matter, there are slight differences between normal individuals, although for the present purpose these can well be disregarded.

Since this method involves no measurements whatever, and is a free, reasoned estimate based on inspection of the burned area and knowledge of the bodily proportions, to insist upon decimal proportions implies a degree of accuracy beyond what the method affords. The "corrected" proportions are simple and fulfill prognostic requirements. Greater accuracy would be of no particular benefit clinically.

In children the proportions are different. The proportions of head and lower extremities vary considerably, and progressively, with age. Measurements of nearly 500

children confirm the value of the following rule which I proposed for ascertaining the proportions at any given age up to twelve: trunk 40 per cent, upper extremities 16 per cent. For head and lower extremities, subtract age in years from 12 and add the remainder to the number expressing the adult proportion for the head (6). Subtract the same amount from the number expressing the adult proportion for the lower extremities (38).

The proportions so obtained are already corrected to the greater seriousness of burns of the trunk.

I would call attention to the fact, with which I became acquainted about a year ago, that in 1902 Stephan Weidenfeld[3] proposed the use of surface-area ratios for this very purpose. He obtained his ratios from actual measurements of the surfaces of three adults and two children. Considering Weidenfeld's many valuable contributions to the subject of cutaneous burns, the fact that his method did not come into a more general use at that time is rather surprising. I can only attribute this to the difficulty of remembering and calculating from his ratios. In children, his ratios are only for those of two and four years.

In the literature of the past five years there have been a number of references to "the Berkow method." In view of Weidenfeld's priority a combination of names would be fairer.

The method, as suggested by me, has been checked with actual measurements, by Davidson.[4] The results, he found, "have agreed within a very reasonable limit of error." He states also that "measuring is of little value except to get a figure of total area involved." Actual area, as noted previously, is of value chiefly in studying the rate of healing. In this connection the exact work of Carrel and Hartmann[5] and Du Nouy[6] has not, it seems to me, received sufficient attention from clinicians. This shows that the rate of healing of wounds can be expressed by a mathematical equation. From the size

of the wound and the age of the patient the rate of cicatrization can be predicted. Infection (clinical, as against the mere presence of a few bacteria) slows up the normal progress of the wound.

By employing the height-weight formula of du Bois,[7] it is possible to obtain from the estimate of *proportion* of surface involved a fairly accurate figure for the *actual* surface involvement.

Now, the difference between the per cent involved and 100 per cent (the total surface) is the per cent of unburned surface. This is the true basis for prognosis as to life. Tauber[8] suggests that about 20 per cent should be added to the actual (?) burned area in making an estimate of the area of skin that is really not functioning, "as about that area of adjacent unburned tissue is for the time being unable to functionate properly and is completely out of commission." This interesting suggestion has not, to my knowledge, been put to experimental or clinical proof.

The largest per cent of body surface involvement *with recovery* is a burn of 48 per cent reported by Davidson[9] in his classic paper on the tannic acid treatment. The patient was a white man, aged forty-nine. Most of the burn was first degree, some second degree. Treatment was 2.5 per cent tannic acid solution locally, 500 c.c. of 5 per cent glucose intravenously and glucose by rectum. Fluids were forced to 10,000 c.c. daily. The patient was discharged from Henry Ford Hospital on the twentieth day after the accident.

In the same series death followed a burn involving 53 per cent of the body surface.

In children, Seeger[10] reports that

. . . the greatest amount of skin area involved in a patient who recovered was 30 per cent, there being 2 in this group. Two others who recovered had burns involving 27 per cent of the body surface . . . One infant one and one-half years old recovered following a burn of 20 per cent of the body surface. With 1 exception, all of those who died had involvement of 30 per cent or more of the skin area.

Local treatment was with tannic acid.

CONCLUSIONS

1. For purposes of record, comparison, and prognosis, a definite, numerical statement of the relative amount of surface area burned is essential.

2. The surface-area proportions have proved their clinical value for this purpose.

3. The priority of Weidenfeld in recommending this method is brought forward. Basically his conception is identical with my own, which I consider to be better adapted to clinical requirements. The use of both names in the designation is suggested.

4. If the amount of body surface is determined from the patient's height and weight, by the height-weight formula of du Bois or from a table or nomograph based on this formula, the estimated per cent of involvement can be used to determine the actual area burned. This may be important in prognosing the healing time.

5. The prognosis as to life depends upon the per cent of unburned and functioning surface that remains. This is found by subtracting the estimated per cent of burn from 100.

6. From the literature, cases are cited in which recovery ensued after burns involving 48 per cent of the body surface in an adult and 30 per cent in each of two children. Further reports of this nature would be of inestimable value for prognosis.

TABLE I

COMPARISON OF ADULT RATIOS ACCORDING TO WIEDENFELD WITH ADULT PROPORTIONS ACCORDING TO BERKOW

Parts	Ratios (Wiedenfeld)*	Proportions (Berkow)† (Per Cent)	Parts
Head............	1:21	6	Head (including neck)
Neck............	1:47		
Trunk..........	1:3.7	38 (anterior surface 20) (posterior surface 18)	Trunk
Arms...........	1:10	18 (arms ¾ of total)	Upper extremities
Forearms........	1:14		
Hands..........	1:24	(hands ¼ of total)	
Thighs..	1:4	38	Lower extremities
Legs............	1:8		
Feet............	1:14	(thighs ⅚ of total) (legs ⅔ of total) (feet ⅙ of total)	

* Average of 3 cases, from areas actually measured.

† Average of 25 cases, from areas determined by means of the linear formula of Eugene du Bois; corrected to the greater seriousness of burns of the anterior surface of the trunk.

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INFECTIONS OF THE DISTAL PHALANX OF THE THUMB*

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THOUGH but a relatively small portion of the body, the distal phalanx of the thumb if infected becomes of aspects of the bone. The epiphysis is supplied by the digital arteries before they enter the closed space. If, therefore,

FIG. 1. July 1, 1928, showing advanced necrosis disseminated of diaphysis of distal phalanx; entire epiphysis is intact.

FIG. 2. July 20, 1928. Areas of necrosis have been removed, leaving a well-defined epiphysis and no sequestra.

extreme importance. The proper management of its infections and its restoration to normal are imperative. Skilled labor or even housework is difficult without a perfectly functioning thumb. One need only try to pick up a small object such as a pin or a coin to prove this point. Then, too, the dangers of infection are not to be ignored.

In the distal phalanx, the subcutaneous tissue consists of a number of strong fibrous septa which radiate from the periosteum to the skin. In the compartments between the septa is fatty tissue. The distal four-fifths of the phalanx are a closed space, and together with the diaphysis receives its blood supply from two digital arteries which are found on the anterolateral

inflammatory exudate occurs therein, it cannot escape at all freely, so that when tension obstructs the blood supply, necrosis of the diaphysis is caused. Even after union of the epiphysis and diaphysis, necrosis is generally limited to the diaphyseal region, the base remaining intact except in late, neglected cases.

Such minor injuries frequently cause amputation of fingers for gangrene because of neglect or mishandling. Permanently crippled thumbs might have been saved with a better knowledge of the destructive action of antiseptics, instead of using fomentations and unnecessary squeezing. Infection of the distal phalanx of the thumb may be classified as: (1) subcuticular, (2) subcutaneous, (3) subperiostal. The

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FIG. 3. July 17, 1928, beginning bone restoration and decrease in swelling of soft parts.

FIG. 4. August 10, 1928, taken five weeks after Fig. 1 shows marked advancement in restoration, phalanx being two-thirds completed. Soft part swelling has disappeared and osteoporosis is present in both distal and proximal phalanx.

FIG. 5. September 18, 1928, three-fourths of distal phalanx restored. The thinning out of bone shadow is due to osteoporosis and not to any extension of bone infection.
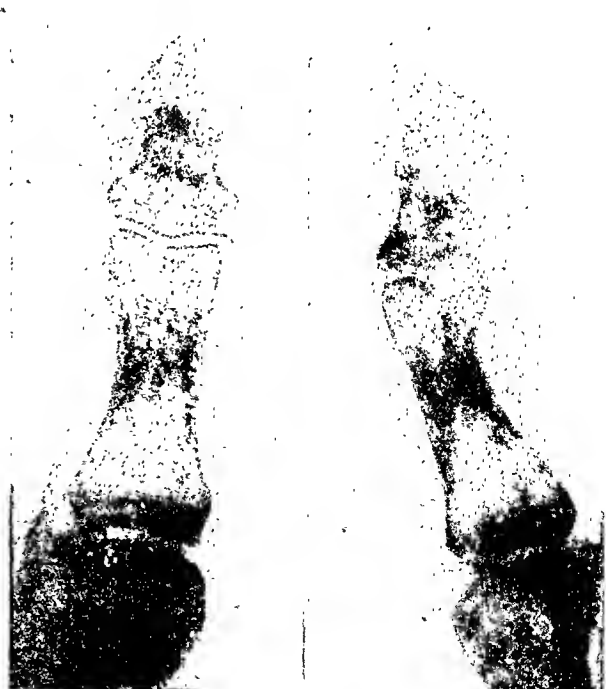
FIG. 6. Dec. 4, 1928, disappearance of osteoporosis and nearly complete phalanx formed.

first and second only will be considered here.

1. *Subcuticular-purulent* blister generally
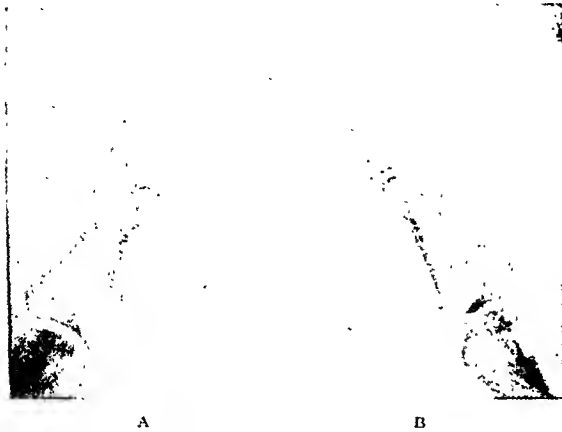
FIG. 7. Beginning restoration of the distal phalanx after severe necrosis.

results from pricking of finger or infection following a careless manicure. A collection of pus raises the epidermis from the dermis.

space. If present, it must be freely incised. A troublesome form of subcuticular infection is that affecting the nail fold, known as paronychia. A subcuticular abscess may form under the nail fold which may need incision, raising of cuticle. More chronic and more difficult to treat is a condition in which the nail fold becomes thickened and a small amount of pus occasionally exudes from beneath. It usually burrows under nail, between nail and matrix. Exuberant growth soon forms around nail and separates it from its bed.

In early cases it suffices to pack gauze and rubber tissue between nail fold and nail. More chronic cases necessitate parallel incision on each side of nail bed; nail fold is lifted up and nail bed cut away from matrix. Drain is inserted between matrix and flap and hot magnesium sulphate dressing applied. This type rarely involves bone. If a middle longitudinal

FIG. 8. Severe type of necrosis of distal phalanx. The small piece of epiphysis remaining was sufficient for fully restored phalanx.

FIG. 9. Necrosis of upper and inner part of distal phalanx which shows retardation of necrosis due to proper incision and relieving of pressure in closed space.

Treatment: Dead skin removed with a scissors and exposed area carefully examined for a small opening through which pus may be escaping from the subcutaneous

incision is made, the new nail may be permanently split longitudinally.

11. *Subcutaneous:* This is a cellulitis of

finger which usually goes on to suppuration, the results from punctured wounds, with redness, heat, swelling, pain, and loss of
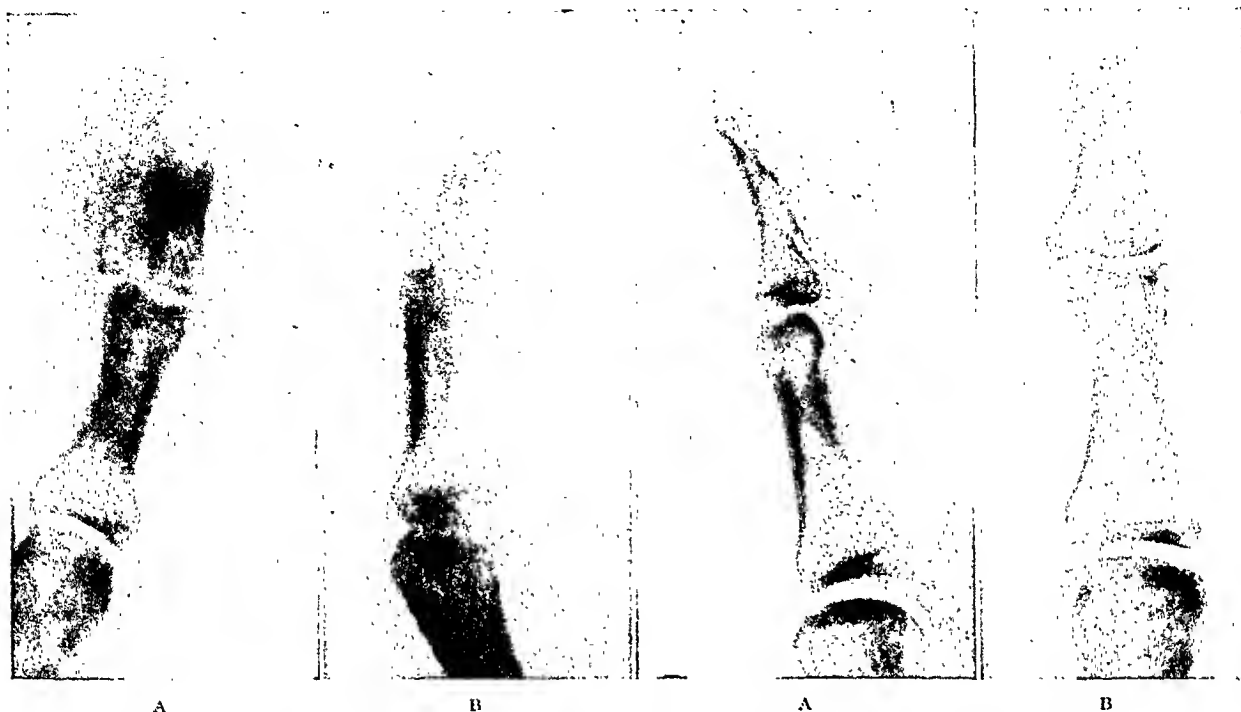

FIG. 10. Necrosis of distal phalanx with diaphysis remaining as sequestra. Many times diaphysis becomes dislocated. Removal of diaphysis in these cases hastens restoration of phalanx.

function. Pain becomes worse and throbbing in character. Pus may be present long before fluctuation is perceived. This type occurring in terminal phalanx of thumb deserves careful consideration as the closed space is involved and necrosis of bone may occur in forty-eight hours, and then pain is relieved. Osteitis is usually a complication of subcutaneous whitlow. It occurs frequently in terminal phalanx of thumb because of its anatomy. Occasionally it may be of a hematogenous source.

Treatment: All except subcuticular infection not affecting nail fold require general anesthesia, gas oxygen preferably. A tourniquet should not be used as it lowers the resistance of the parts and favors spread of infection. A horseshoe-shaped incision parallel to nail and about ⅛ in. anterior to it is made. It has much advantage over anterior incisions because scar is remote from site of pressure. Tension is relieved in closed compartment of finger.

Sloughing tissue should be removed. Condition of the bone is noted. If part of bone is loose, it should be removed. Rubber

FIG. 11. Mild case of osteitis secondary to soft part infection, which clears up with no need for curetting of bone.

drain is inserted and daily dressings of wet magnesium sulphate applied.
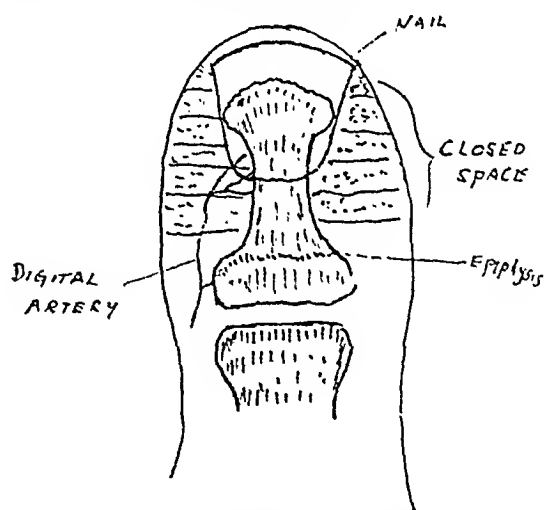
FIG. 12. Closed and opened spaces of thumb with arterial supply.

In complications, subcuticular, if paronychia is present, nail may be lost. Necrosis of diaphysis frequently follows.

Necrosis of the phalanx may be secondary to any subcutaneous infection, and as

heretofore stated, the greater part of the terminal phalanx is a closed space, so that when inflammation occurs, exudation results, and tension leads to further exudation. This, in turn, leads to further pressure on the veins. Finally vascular thrombosis results, followed by necrosis of the diaphysis of the terminal phalanx, the base commonly escaping owing to the origin of its blood supply from without the closed space. Necrosis or osteitis of the phalanx, after a few days show in the roentgengram according to the type and severity of the infection. The osteitis may involve the tip of the bone or the entire diaphysis, and may be classified in two types for discussion, i.e., mild and advanced.

The mild type generally attacks the upper third and tip of the phalanx in some instances leaving a small sequestra. With proper incision and removal of any sequestra, these cases go on to recovery with complete restoration of phalanx.

The more severe type attacks the entire phalanx. As the epiphysis is at the lower fifth of the phalanx and outside of the enclosed sac, it does not bear the brunt of the vascular thrombosis. A line of demarcation forms at the junction of the diaphysis and epiphysis. As the infection progresses, the diaphysis becomes detached from the epiphysis, altering the size, contour, and position, becoming separated into many small fragments, and acting as a sequestra. With proper drainage and removal of the sequestra, the entire phalanx undergoes restoration, a complete phalanx being formed after several months. In severe infections, part of the epiphysis becomes dissolved, but so long as a small part of it remains, restoration will go on.

Bearse's method is to make an inverted u-shaped incision around end of finger. After flaps are separated, all of the necrotic bone is removed. To facilitate draining gauze packing is placed between the flaps. Packing is changed every other day until drainage becomes scanty. The flaps being placed in opposition without suturing are so retained until thumb is healed.

The accompanying x-rays illustrate the restoration of a phalanx after a marked necrosis. The case is only one of many:

Mr. Z. came to my office July 13, 1928, for treatment of an infection of his left thumb, which was of two weeks' duration, having been treated by a colleague who made an incision for drainage. X-ray examination (Fig. 1) revealed an advanced necrosis, disseminated, of the distal phalanx. The necrosis involved most of the diaphysis, a small part remaining intact with the epiphysis. Following the x-ray examination, a horseshoe incision was made and all small sequestra removed and wound drained.

Figure 2, July 20, 1928. Shows an absence of the numerous small sequestra and beginning bone restoration.

Figure 3, July 27, 1928. Shows an advancement in bone reparation and no evidence of sequestra.

Figure 4, August 10, 1928. Shows two-thirds of a well-formed phalanx, growing from the epiphysis upward towards the tip. Restoration had not progressed completely to give the rounded contour to the tip.

Figure 5, September 8, 1928. Shows progessive bone reparation. Due to the noncomplete usage of the infected thumb, a condition of osteoporosis has developed in both the distal and proximal phalanx, giving an appearance of rarefaction which wrongly is mistaken for an extension of the infection. Strict caution should be instituted before a final decision.

Figure 6, December 4, 1928, less than six months since the first roentgenogram, shows the phalanx nearly complete and an improvement in the osteoporosis due to the usage of the now nearly fully recuperated thumb. Further plates were not taken, due to the lack of cooperation of the patient.

SUMMARY

Infection of the distal phalanx undergoing necrosis with complete destruction of the diaphysis and even as much as seven-eighths of the epiphysis involved, will have a tendency to go on to complete bone restoration of the phalanx, if suitable drainage is instituted and sequestra removed.

The removal of sequestra hastens restoration; the non-removal will cause delay in waiting for them to be discharged from the wound, and may destroy neighboring healthy tissue.

The diaphysis bears the brunt of the necrosis, being within the upper four-fifths of the phalanx (closed space) while the epiphysis which is in the lower one-fifth does not, being outside the closed space.

A horseshoe incision at tip of finger not extending below the upper four-fifths of the phalanx is the incision of choice.

Necrosis in a mild case does not necessarily call for curretting for improvement.

While the receding of the flaps made by the horseshoe shaped incision may dwarf the growth of the phalanx, sufficient packing will prohibit this.

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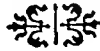
A SIMPLE SURGICAL METHOD FOR THE ESTHETIC CORRECTION OF
. PENDULOUS BREASTS*

M. G. DerBrucke, m.d.

BROOKLYN, N. Y.

IN the past, a number of methods have been propounded for the correction of pendulous breasts. Yet those who sought to secure the cosmetic effect endangered the function of the glandular and galactophorous elements, while the group who were intent upon reducing the size, not only involved the breast tissue proper but left unsightly scars.

The true pendulous breast is one in which the glandular, galactophorous and fatty elements are suspended in the lower pole, like a soggy sponge in a large thin bag. In this type we can easily grasp, between the thumb and the index finger, the anterior and posterior skin layers and approximate them. The pendulosity usually varies with the amount of attention and care it receives. In the patient I treated it extended down to the umbilicus, the nipple being 12 in. from the midclavicular region. This she had acquired by continually pulling the breasts down, in order to obtain the questionable form of the masculine. For this type, it sometimes becomes an economical problem, especially so if the women are models or dancers. It is for them that a truly cosmetic and corrective measure must be obtained. If, to these prerequisites, we can eliminate morbidity, avoid any possible interference with function, immediate or future, and allow the women to go on with their work even if moderate, I feel we have attained as near the ideal operation as is possible.

If we can realize that the size and amount of fat deposited in the breasts are dependent upon the general metabolic state of the individual, we soon see that we cannot give to a woman who weighs 250 lb. breasts of a Folies Bergere, nor to a small puny one, those of a Venus de Milo. But in a selected patient with an otherwise well proportioned body, a great deal can be done toward the restoration of the normal form without extensive resection of the gland tissue.

Joseph, Passot, Frist, using Lexer's method; Glaesmer, Axhausen, Lotsch, all either resect part of the breast or transpose the nipple into a newly made bed, or do both. The risks of necrosis, infection, sloughing of the nipple or even possible gangrene due to tortion of the vessels and ducts are too great to classify these among the operations of choice. DeQuervain simply resects the breast from its submammary fold and attaches it to a higher level on the pectoralis fascia. Noel and Lopez-Martinez remove crescentic shaped pieces of skin above the areola, this being done in two or three stages, each time bringing the scar closer to the areola. The cosmetic effect is excellent.

Adopting the principle of Lopez-Martinez to a certain extent, I have devised a method which I believe fulfills all the necessary requisites. With the patient in the erect posture, and completely relaxed, I measure the length of the breast, using a line drawn from the midclavicular point down to the nipple. The breast is then raised to the preferred height, and the distance is again measured. The difference between the two is the approximate amount of elevation desired. With an applicator dipped in methylene blue, a crescentic shaped area, half the size or perhaps a little more than half of the amount of elevation to be obtained is marked off. The concavity of the crescent faces the areola. A similar area is likewise mapped on the under surface. With a sharp scalpel the upper markings are retraced. The methylene blue is then removed with alcohol. The skin is carefully bisected until the glistening

fascia immediately above the fatty and glandular elements comes into view. Up to this time practically no bleeding is encoun-
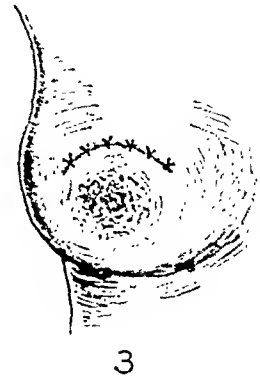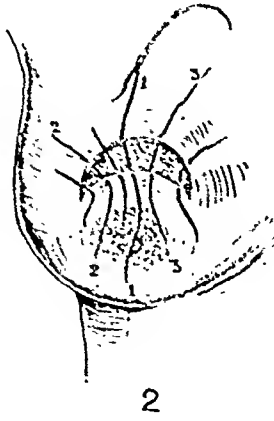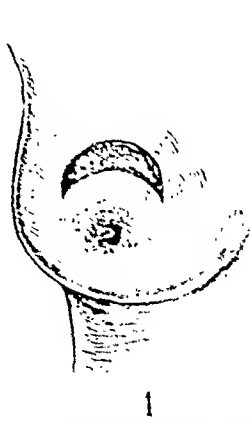

FIG. 1. Crescentic area excised above areola.
FIG. 2. First suture is placed in center of excised flap. Sutures 2 and 3 are placed equidistant on either side of suture 1.
FIG. 3. Scar above the areola at end of primary operation.

tered. Gently the fascia is cut. As this is done the fat and breast tissue pops through the nicked area. This is proceeded with until the entire skin flap is removed (Fig. 1). If done very carefully the field is almost entirely dry throughout the pro-

under surface of the breast is treated similarly. The assistant then holds the breast upward and inward. A 3 in. wide adhesive strap is placed below the breast on the abdominal wall, and then drawn tightly upward and over the outer border of the breast, across the corresponding shoulder to the back. In the same fashion another strap is placed on the sternal
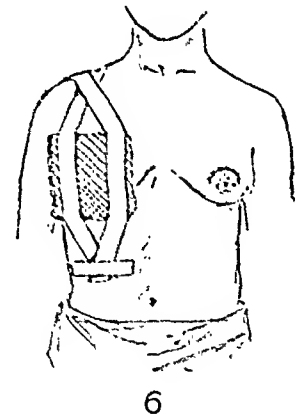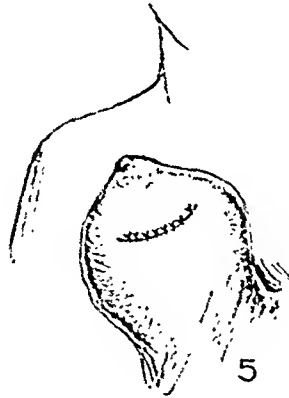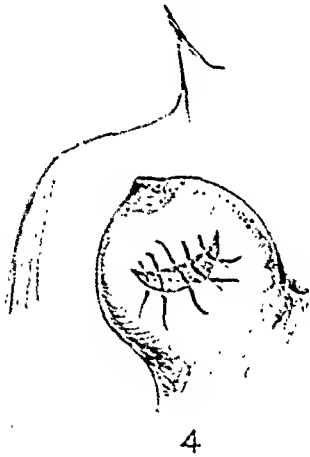

FIG. 4. Excised area on under surface with some of sutures in place.
FIG. 5. Closed wound on under surface at end of primary operation.
FIG. 6. Application of adhesive straps are so placed as to allow wearing of usual clothing with minimum exposure of dressings.

cedure. The edges of the wound are approximated with chromic gut 0, placing the first suture in the center and the next two so that each of the newly created sectors are again bisected (Fig. 2). This avoids puckering. The sutures are threaded on a straight surgical needle. Each stitch includes the skin and fascia only, care being taken to avoid the fatty tissue. The

border. This makes a fairly snug support. The patient can wear ordinary street clothes, with very little, if any, dressing showing. She is allowed up and out of bed the following day and in another may assume her daily routine (see Figs. 3–6).

In ten days the dressing is removed. Some of the sutures are simply brushed off, the others are removed. Two things

become immediately apparent. The breasts are definitely higher, from 2 to 3 in., and as a result of the tight dressing there is a
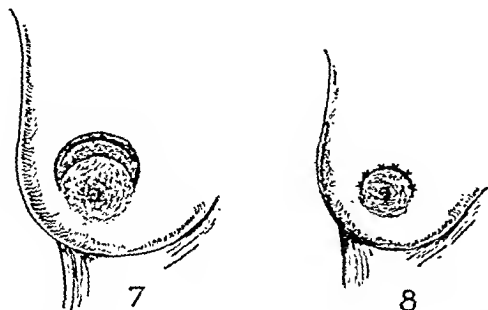

FIG. 7. Secondary operation. New crescent so made as to include primary scar in upper arc, and upper border of areola in lower arc.
FIG. 8. Relation of new scar to areola.·

redundancy of skin at the sternal margin of the mammae. At least, there has been no new deposition of fat and perhaps some of the old has been consumed by the general metabolism of the body. Evidently the

the upper arc is just above the old scar, while the lower arc is at the border of the areola. This flap is treated as in the first instance. A little more bleeding is encountered. This is carefully checked. The new suture line is in or at the areolo-cutaneous junction (Figs. 7 and 8).

The breast is turned upward. With methylene blue an arc is drawn immediately in front of the old scar. Another arc which begins just inside the sternal border of the breast and $1\frac{1}{4}$ in. above the submammary fold is then so made that its outer end converges to meet the outer end of the upper one. The inner side being now returned to, the open ends of the arcs are joined by a v-shaped line, the point of the v being directed toward the united ends of the arcs. The size of the v depends upon the amount of redundant tissue in this area. The outlined flap as it now appears looks like the letter M lying
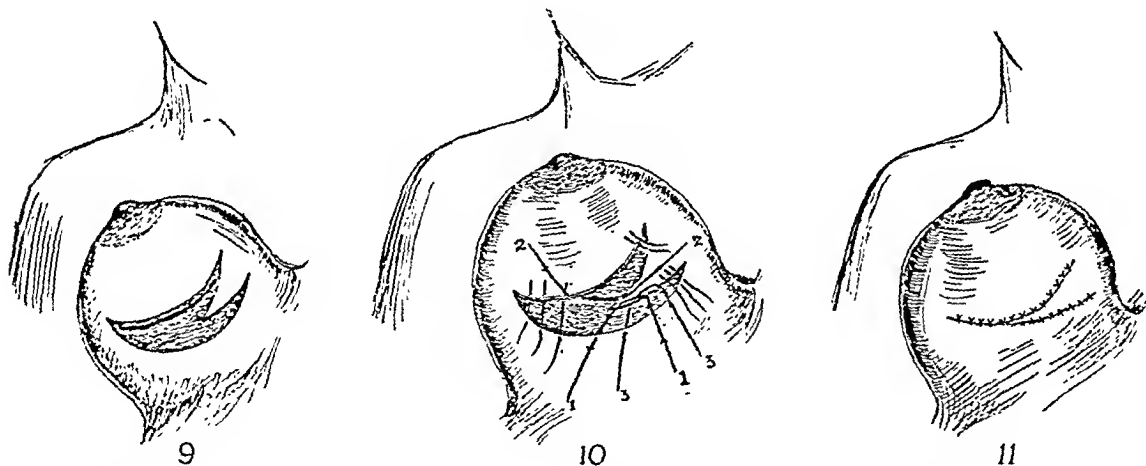

FIG. 9. Reclining M-shaped excision on under surface of breast, showing inclusion of primary scar.
FIG. 10. Placing of suture No. 1 depends upon amount of puckering of skin at mesial border of breast.
FIG. 11. Appearance of scar on under surface of breast at conclusion of secondary operation.

redundancy in this region is due to the natural tendency of the breasts to turn outward, in the relaxed condition. During the ensuing month the wounds are covered with as little dressing as is commensurate with safety. They are permitted to hang freely. Thus ends step one.

We now proceed with the last half of the operation. Again a crescentic area is marked off above the areola. This time

on one side with the lower end sealed. The concavities of the arcs must always be towards the nipple. The part thus enclosed is excised (see Fig. 9). The v is then drawn downward and outward. The extent of traction is guaged by the amount of puckering. The lower end of the v is sewn to the lower arc, while the upper arc is approximated to both the upper part of the v and the remainder of the lower arc

(see Fig. 10). The reclining M has been converted to a reclining Y (Fig. 11). The breast has now been raised an additional 2 or 3 in. The upper scar is masked by the pigmented areola, the lower by the breast itself. The dressings are of the same type as in the first part.

There has been no resection of breast tissue. The circulation and nerve supply of the areola and the nipple are not interfered with. The galactophorous ducts are not disturbed by any transplantation of the nipple. The dangers of infection and fat necrosis are minimal. The visible cosmetic effect is that of a normal breast. The patient need no longer resort to specially constructed brassieres. She can wear a low cut garment with perfect safety.

It might be interesting to add that the menstrual periods of the patient upon whom I performed this operation, following it, were of the normal twenty-eight day interval with no pain, while for a long time previous the periods were at twenty-one day intervals with hypogastric pains which were becoming progressively worse.

In conclusion, for the uncomplicated pendulous breasts, this procedure is one of choice, because;

1. It is simple in execution
2. There is no distortion or destruction of vital tissue
3. The cosmetic result approximates the normal
4. The dangers of infection and interference with lactation are minimized
5. There is no economic loss of time
6. The end-results are gratifying to all concerned.

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THE ETIOLOGY OF ANAL CANCER*

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THE incidence of malignancy of the anal canal has been variously estimated at less than 1 to greater than 10 per cent of all rectal cancers. This variation arises largely from differing conceptions of the anal limits: the lower figures are found where only the skin-covered orifice is included, the higher where the anatomical description is followed. Gray[1] defines the pars analis recti as beginning at the level of the apex of the prostate and ending at the orifice, a geographic division necessarily followed in this discussion as the canal so described is that portion which (1) forms an angle with the lower rectum (2) is narrowed by the sphincters and levatores and (3) is the site of anal pathology.

Thirteen cases of malignancy originating in the anal canal have occurred in my own series of rectal cancers, and a study of the histories obtained and of the tissue findings in these cases forms the basis of this contribution.

The chronic irritation theory has been generally adopted in connection with the origin of malignancy. The *Journal of the American Medical Association*[2] for example said editorially recently, "The trend of results of recent cancer research here summarized is in support of the old view that cancer is usually the result of protracted stimulation of the growth of tissue by non-specific agents," and *Surgery, Gynecology and Obstetrics*[3] in August declared editorially (through W. J. Mayo), "Cancer never develops in sound tissues." Ewing, in a lay publication in 1927 stated, "It is a fortunate fact that most cancers are preceded by various forms of chronic irritation many of which we can detect and thus prevent cancer. Since about 1860 cancer has become recognized more and more as the result of chronic irritation."

The application of this theory to rectal cancer exclusive of the anal canal has also been generally accepted in connection with preexisting adenomas, (Yeomans[4] and many others) and chronic colitis (Bargen[5] and others).

If it is true that unsound tissues in the anal canal, resulting from the long-continued existence of various forms of common anal pathology with infection and irritation, have the same provocative reaction in susceptible subjects as do similar tissues in other parts of the body, it becomes an unfortunate fact that the weight of written authority has up to this time discouraged the very logical resulting conclusion. Ewing[6] (who seems to base his statement largely on an expression from Kraske some years ago) has been widely quoted to the effect that a tissue predisposition appears definitely only in those cases arising on multiple polyposis, that there is no satisfactory evidence that cancer develops in tissue altered by hemorrhoids, fistulae, or cicatrices and that in the 38 per cent of cancers of the pars perinealis reported by Zinner[7] to complain of hemorrhoids, the latter were uniformly the result rather than the cause of the malignancy. Pennington[8] rejected the entire irritation theory and believed hemorrhoids when present were a mere coincidence. Lockhart-Mummery[9] ardently supports the adenomata theory in the rectum, grants the occasional occurrence of cancer in fistulous tracts but doubts the etiological significance of other benign anal pathology.

At the onset it is essential clearly to define our premises, which has not been done in much of the literature on this subject. It cannot logically be contended that lesions in the anal canal influence the development of malignancy in the ampulla

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or at the rectosigmoid junction; here the double lesion is clearly purely coincidence. Nor is it my contention that anal cancer necessarily develops *directly* from the prior benign lesion; polyp formation may and no doubt does play a part in the origin of cancer of the upper portion of the anal canal, where glands are present and where adenocarcinoma may develop, but the inflammatory or irritative origin of adenomas is generally conceded and the possibility that the adenoma is secondary to an old anal lesion remains.

A review of the literature since 1915 reveals that 18 specific instances in which malignancy has developed in benign anal lesions have been reported by ten observers, in addition to a number of vague references to cases observed by others. The preceding lesion is given as piles in 7 instances (Hirschman and Rosenblatt,[10] Yeomans,[11] Plisson[12] Howe and[13] Gibbes[8]). Sarcoma resulted in 1 case, epithelioma in 2, colloid carcinoma in 2, and adenocarcinoma in 2. In 4 cases the length of the hemorrhoid history was mentioned: fifteen years, seventeen years, twenty years, "a long time."

Seven fistulae resulting in cancer have been reported (Moon,[14] Yeomans,[11] Fitchet,[15] David,[16] Pennington[8]), two adenocarcinomas, one colloid carcinoma, two epitheliomas, one basal cell cancer, one not stated. The fistula had been present, when stated, "more than two years," six years, ten years, twenty years.

Three cases of pavement-celled epithelioma from leucoplakia have been reported by Brofeldt[17] and 1 case of epithelioma in an imperforate rectum (McCray[18]).

In my own opinion this group of cases is a tremendously inadequate representation of the true picture and it is suggested that two factors are responsible.

Such a logical sequence is not thought worthy of special record by the casual observer; or in instances where cancer has overgrown the original benign lesion the significance of past symptoms is overshadowed by the present tragedy of malignancy.

My own cases may be briefly summarized as follows:

CASE I. L. B., a white woman of sixty-one

FIG. 1. Case 6. Specimen and sections showing development of tuberculosis and later adenocarcinoma in old fistula.

was operated upon in 1922 for a fistula of three years' duration and an anal polyp found near the internal opening. One year later the polyp was found to have recurred, the tissue being adenocarcinoma. Path. (#23-1431 Baylor.)

CASE II. T. E. J., a white grocer of fifty, with a history of hemorrhoids and fistula

for six years was found to have a small warty growth at the outlet of two fistulous tracts. Each growth was made up of squamous celled
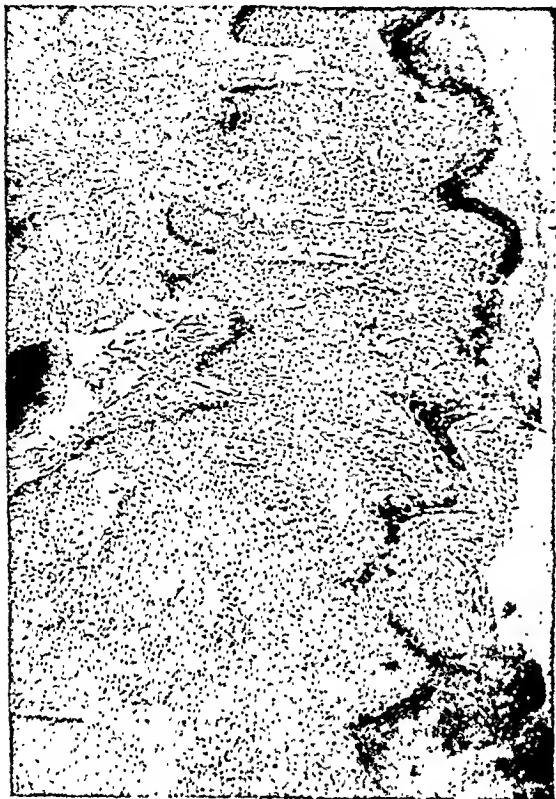

FIG. 2. Case 8. Squamous cell cancer arising in piles with ten year symptoms.

carcinoma. (City County Rectal Service, Path. #26-215.)

CASE III. E. L., a Mexican male of fifty, with a fistula history lasting ten years, was found to have a large friable mass involving all the tracts, which was clinically adeno-carcinoma. No lesion was found above the anorectal line.

CASE IV. V. H., a negro woman of fifty had a history of fistula for fifteen years. A dense mass was present about the single fistulous tract and a small elevated ulcer was seen at the outlet. The ulcer was found to contain adenocarcinoma and the entire tract was lined with the same tissue. The dense mass was fibrous tissue infiltrated with cancer. Although the process was believed to originate at the internal opening at the anorectal line, no definate lesion could be made out above this point. (Path. #27-1786 Baylor.)

CASE V. E. J., a negro female of fifty in the Rectal Service at the City County Hospital, gave the history of fistula for one year. Grossly there was no suggestion of malignancy, but tissue removed showed microscopically areas of adenocarcinoma and a few months later, resection not being done, the wound was a mass of friable adenocarcinomatous material. (Path. #28-215 and #28-584.)

CASE VI. M. C. T., a negro male of fifty-seven, had a history of persistent fistula for fifteen years. A number of sections were made on 1-22-29 which demonstrated poorly defined nodular areas in which were seen Langhans' giant cells. Tissue removed three months later was found to contain adeno-carcinoma in addition to the tuberculous inflammation. (Path. #29-106 and #29-641. Fig. 1. Baylor.)

CASE VII. J. B., a negro male of sixty, developed a fistula one year before admission to the Rectal Service at Baylor Hospital. Six months before admission, his symptoms were complicated by the addition of hemorrhage, anal pain and constipation. Examination revealed an annular gelatinous adenocarcinoma above and in contact with the anorectal line which was invading the fistulous tract. (Path. #30-479.) Considerable doubt exists here as to the priority in time of the fistula, but taken in conjunction with the other cases, the history is suggestive.

Seven cases are reported in which fistula had been present before the discovery of anal cancer, for fifteen years, (2 cases) ten years, six years, three years, and one year (2 cases). One patient had been operated on a year previously for fistula and an adjacent anal polyp removed, the latter showing recurrent adenocarcinoma upon admission to Baylor. Another had small warty growths at the external openings which contained squamous celled cancer. In five others adenocarcinoma was found invading fistulous tracts, apparently originating at internal openings but (Except in Case VII) without tumor formation at this point. Of these 5, 4 were negroes which is interesting in view of the comparative rarity of rectal cancer in the negro.

CASE VIII. M. W., a white school teacher of fifty-five had a history of passing bright red blood after stool, together with protrusion closed large internal hemorrhoids and an indurated anal ulcer lying between two piles, above and impinging on the dentate line.
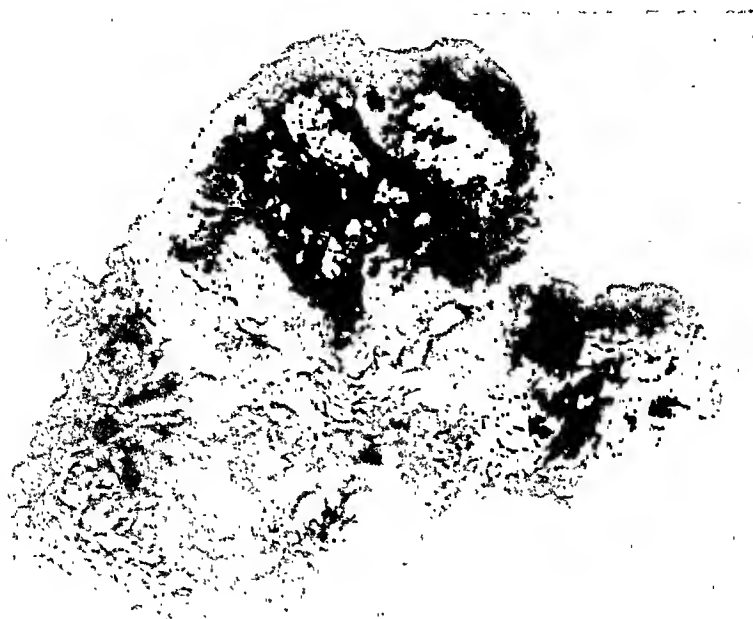

FIG. 3. Case 9. Specimen and photomicrograph of squamous cell cancer arising at dentate line in ancient piles.

of pile masses for ten years. Examination revealed large hemorrhoids, a hypertrophied anal papilla, and in one internal-external pile a firm mass the size of a pigeon's egg. Pathological report on mass (#23–909, Baylor) "firm grayish red tissue with skin attached showing many cells invading tissue in all directions. Some mitotic figures. Epidermoid cancer, squamous cell type" (Fig. 2).

CASE IX. E. M. W., a white housewife of fifty stated that she had experienced intermittent bleeding and protrusion of piles for twenty years. Three weeks before admission her symptoms were complicated by the addition of excruciating anal pain. Examination dis-

The pathological diagnosis was squamous cell carcinoma (#24–302 Baylor Rectal Service) (Fig. 3).

CASE X. F. M., a white woman of seventy-seven reported that she had suffered with protruding piles for thirty years. Ten months before she came to my office her hemorrhoids ceased to protrude but pain and passage of blood-stained pus began. Examination disclosed an indurated anal tumor which was (clinically) epithelioma with extension to the inguinal glands.

CASE XI. J. O. M., a white housewife of fifty-six reported that for eleven years she had noticed bleeding and protruding piles.

Some months before entering Baylor Hospital protrusion had gradually ceased to occur and anal pain and discharge had developed.

FIG. 4. Case 11. Adenocarcinoma replacing piles of eleven years' duration.

Examination disclosed an annular ulcer occupying the exact limits of the internal hemorrhoidal zone above the dentate line, which was microscopically adenocarcinoma (Fig. 4).

Four cases were seen giving a history of bleeding and protruding hemorrhoids for periods varying from ten to thirty years. In one a squamous celled malignant ulcer was found lying between two ancient piles and extending upward from its origin at the anorectal (dentate) line, in another a firm mass the size of a pigeon's egg lying in a prolapsing interno-external hemorrhoid was found to contain epithelial cancer, in the other 2 cases the hemorrhoids had been completely replaced by malignant tissue, adenocarcinoma in Case XI and epithelioma in Case X.

CASE XII. H. L. B., a white woman, aged sixty-five entered Baylor with the complaint of anal bleeding and pain for eight months. Before that time she had noted only mild

irritation for a period of years. An adenocarcinomatous anal ulcer (Path. #29–1602) was present, impinging on the dentate line

FIG. 5. Case 12. Adenocarcinoma developing in presence of chronic cryptitis and papillitis.

which showed marked chronic cryptitis and papillitis (Fig. 5).

CASE XIII. C. G., a Mexican woman of sixty-five was admitted to the Baylor Rectal Service with a large protruding anal mass present for several years. The patient spoke no English, and the history obtained through an interpreter failed to reveal any definite story of prior anal pathology. The mass was found to be a Grade 3 adenocarcinoma.

In 1 case the gross specimen revealed the presence of chronic cryptitis and papillitis, in another no prior history of anal disorder was obtained.

In the entire group there were 4 males and 9 females; 7 Caucasians, 4 negroes, and 2 Mexicans. The average age of the group was 57.3 years; none were under fifty.

I have seen no cases arising from pruritis, although Brofeldt[17] has reported 3 arising on leucoplakic epithelium. In view of the present opinion that 40 per cent of primary

epitheliomas of the vulva originate from vulvar pruritis,[19] one would expect a greater reported incidence of anal cancer from this lesion. I recently removed a perianal papilloma arising on pruritic skin in a male of fifty-four who had itched for twenty years.

The records of Baylor Hospital reveal 2 additional anal cancers occurring as a consequence of benign pathology. One was a male of forty-eight whose anal fissure was the site of an epithelioma after three operative procedures during a period of six years had failed to cure the ulcer. In another an inflamed anal tag was the site of cancer with metastasis to the inguinal glands.

SUMMARY AND CONCLUSIONS

1. A series of 13 cases of anal cancer occurring in the writer's own rectal services, are reviewed. In 12 of these benign anal pathology is believed to have been present before onset of malignancy and to have brought about a local tissue predisposition.

2. In addition 18 such cases from the literature and 2 from other services at Baylor Hospital are reviewed.

3. It is suggested that a more general investigation of the prior history and local findings will multiply the number of similar reports.

4. Admitting the possibility of coincidence in some cases, it is believed that there is satisfactory evidence that anal cancer may develop in tissue altered by hemorrhoids, fistulae or cicatrices.

The author is indebted to Mr. Lewis E. Waters of the Department of Anatomy, Baylor Medical College, for drawings and photomicrography.

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PROSTATIC ABSCESS:

A CLINICAL STUDY OF 42 CASES*

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IF one were to judge, either from its treatment in the common texts or from its management in ordinary surgical practice, one could not avoid the conclusion that, commonplace as it may seem to be, there still remains plenty of opportunity for further consideration of the whole subject of abscess of the prostate and for more complete accord in the matter of its diagnosis and its treatment. As a basis for this presentation, a detailed study has been made of 42 cases of proved, frank abscess of the prostate.

ETIOLOGY

In considering the etiology of prostatic abscess, one is, of course, at once struck with its association with gonorrhea. This is especially true because of the large number of patients who, at the peak of a posterior gonorrhea, have such a violent associated prostatitis that only days of careful observation will permit the exclusion of true prostatic abscess. In spite of the prominent part gonorrhea has to play in its etiology, however, abscess of the prostate can and does occur entirely independently of gonorrhea. One-fourth of the cases in this series had neither history nor evidence of recent or active gonorrhea. In at least 4 of these patients, not only had there never been a gonorrhea but there was a very definite clinical picture of metastasis from infection elsewhere. These cases seem worth reciting. One case developed two weeks after the onset of an extensive furunculosis. A second occurred at the height of an attack of acute rheumatic fever. A third followed promptly upon some dental surgery for a foul, chronic gingivitis. Yet another occurred one week after the lancing of an acute abscess formed at the site of a chronic os-

teomyelitis of years' duration. One patient in this series had a staphylococci abscess superimposed upon a proved prostatic cancer, certainly not a venereal abscess. In still 5 other cases there was nothing in the history or findings even suggesting gonorrhea as an etiological factor.

DIAGNOSIS

It has already been stated that a frank, fully developed abscess was proved in each of our 42 cases. When this is considered, together with the fact that our records show no other patient on whom prostatotomy was done, it must be evident that we have erred on the side of non-intervention when abscess was in question. This is made more evident by the number of instances in this series in which operation was done a week or two after the possibility of abscess was first considered; in one instance after ten days of complete retention.

Three of our patients ruptured into the urethra spontaneously, and a fourth was unintentionally ruptured on a Kollman dilator. Of the three fatalities, one died of ileus the fourth day after suprapubic rupture with the finger in a effort to enucleate what was thought to be a benign hypertrophy but at necropsy proved an abscess within a cancerous gland; a second died on the table, being moribund with peritonitis when first seen. The third was particularly interesting in that it presented a classical picture of fulminating appendicitis. Appendectomy was promptly done and autopsy the following day disclosed a pelvic phlegmon emanating from a prostatic abscess.

It seems no apology need be offered for these fatalities, at least from the standpoint of undue delay in diagnosis. With

that granted, there has been nothing in our experience to dissuade us from the position that there is complete safety in the careful observation of a suspect until definite abscess formation is evident. This position is certainly strengthened by the large number of acute gonorrheics whom we all see, having frequency and dysuria, a prostate large and tender, and even some fever and urinary difficulty, and yet whose symptoms ultimately subside and disappear under judicial expectant treatment.

With the textbook picture in mind, there is somewhat of surprise in a review of the diagnostic signs and symptoms in this group of cases of frank prostatic abscess. Frequency and strangury (except, of course, in the event of retention) were a constant complaint. Although but half of these patients experienced rectal or perineal pain, it was our experience that when it was an outstanding symptom and especially when the patient, in sitting, rode the edge of the chair on his thigh, it very strongly suggested frank abscess. Only 6 of these patients complained of chilly sensations and none had a frank chill. Less than half had any fever at all before operation and only rarely did it exceed 3°. Little or no fever seems the rule in prostatic abscess. About half of these patients had complete retention; practically all noted some difficulty in voiding. Though it is far from constant, complete retention seems the most definite of all symptoms of abscess of the prostate.

It is conceivable that the recognition of fluctuation by palpation per rectum is a matter of quite variable personal ability. Certainly, when fluctuation can be felt there is nothing further to be considered, so far as diagnosis is concerned. Notes on these cases of proved abscess show that fluctuation was unquestionably felt in less than one-fourth of them. In the remainder, the prostate was felt tender, enlarged, often tense, and often extending indefinitely up onto one or both seminal vesicles or laterally onto the inner pelvic wall.

TREATMENT

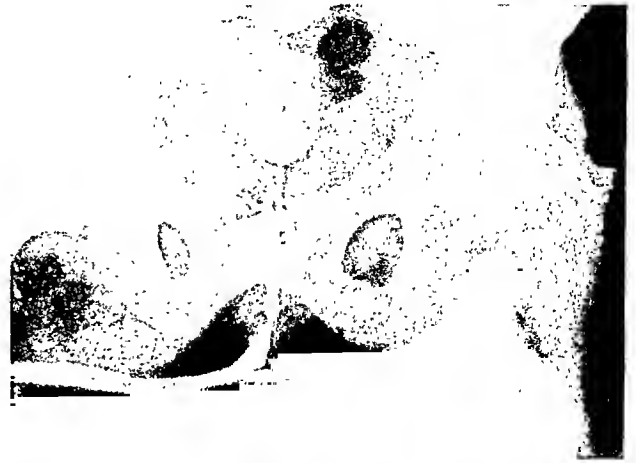A recital of some of the present day teaching regarding the surgical drainage

Fig. 1. Extensive sinus formation in prostate and seminal vesicles as seen through the symphysis bone, lipiodol urethrogram.

of prostatic abscess may prove interesting. Keyes dismisses all other methods with one sentence and then describes in detail the virtues of Stevens' method of blind puncture per urethram with the tip of a sound. Livermore and Schumann favor unilateral perineal incision and blind puncture of the abscess by plunging a hemostat up through the ischiorectal fossa. Chetwood gives about equal prominence to the method of finger rupture through external urethrotomy and the method of posterior prostatotomy through radical perineal dissection. Eisendrath and Rolnick unequivocally recommend radical perineal exposure and posterior prostatotomy. Young is, of course, also of this view. These text teachings are cited merely to show the wide difference of opinions regarding a proper surgical procedure in draining these abscesses.

In our series there were 4 cases of rupture of the abscess per urethram, 3 spontaneously and 1 on an expanded Kollman dilator. These are of some interest in considering the several methods recommended for rupture of the abscess into the posterior urethra. Of these 4 patients, one left the hospital quite well in thirty days. The other 3 were less fortunate. One has persisted with a chronic recurring gonor-

rhea for four years despite all ordinary treatment. A second lingered for three months and finally developed a large ischiorectal abscess, the drainage of which effected cure. A third is still under treatment, two years after spontaneous rupture. He eventually had an external urethrotomy done in an attempt to facilitate better drainage. A few months later he had some sort of perineal dissection in an attempt to correct his urinary fistula. He is still in the hospital, in miserable shape, and we present a lipiodol urethrogram to visualize the extent of false cavity formation that has persisted. Although these cases, per se, cannot fairly be taken as grounds for judgment for or against the Stevens' method of sound puncture, despite the favor of no less an authority than Keyes, the procedure strikes us as being entirely unsurgical and, like spontaneous rupture, altogether too likely to result in permanent false cavity formation in the posterior urethra.

Ten patients in this group were operated upon and the abscess broken into the posterior urethra with the finger inserted through a perineal urethrotomy wound. This procedure necessarily results in a perineal urinary fistula of more or less duration. The average hospital stay of these patients was fifty-two days, and even then exactly half of them were discharged from the hospital with some perineal leakage. Incidentally, one patient so operated suffered a nearly fatal secondary hemorrhage on the twelfth day. Contrast with this, the 21 patients operated by posterior prostatotomy through a completely dissected perineum. The average hospital stay was nineteen days. One had urine draining through the perineal wound for thirty-six hours after operation. A second had a fecal fistula lasting from the eighth to the eleventh day. All the patients left the hospital with wounds perfectly healed and with infinitely less residual urethritis than in the other group.

Epididymitis is naturally a frequent complication of prostatic abscess. It may be of some significance to note that of the 21 patients in whom drainage was done by posterior prostatotomy only *six* epididymi became involved, whereas *eight* epididymi became involved in the 10 cases urethrotomized. These figures are not surprising when it is considered that incision into the posterior surface of the prostatic lobes can be made without danger of injury to the ejaculatory duct, a factor of safety not present in any other recommended type of drainage.

There is much to be said in favor of some such method of drainage as that recommended by Livermore and Schumann wherein the back surface of the prostate is pierced by a hemostat burrowed up, on one side or the other, through the ischiorectal fossa. Such a procedure involves none of the risks attending the various methods of intra-urethral rupture and, in addition, escapes the difficulties of a complete perineal dissection. There seems to be but one drawback to such a method. Its use involves an accurate knowledge as to which lobe is the seat of abscess. In our experience, this has not been as simple as one would suppose. There have been occasions in which the lobe suspected as being abscessed was incised without tapping pus but a frank abscess was opened by incision into the other lobe. More than that, of the 21 patients operated on by perineal dissection, 12 had frankly bilateral abscesses, though the rectal findings rarely indicated such a situation.

There is yet another factor worth consideration in the choice of operation. The various texts seem to emphasize the point that an abscess developing to any considerable size within the prostate tends to point either into the urethra or laterally and downward into the ischiorectal fossa. These are, of course, favorite sites of extension but there have been a fairly large number of our patients in whom the abscess either was primary in the seminal vesicle or burrowed there from its original site in the prostate. In such instances, especially if at all massive, the abscess

cavity, when opened, was found to extend quite deeply into the retrovesicle region. At least in such cases, it would seem that drainage under vision would be far better and safer than any procedure done blindly and by "feel."

In conclusion we believe:

That in any acute prostatic inflammation there is complete safety in waiting until careful observation has permitted a definite diagnosis of frank abscess formation.

That both prostatic lobes should be opened, whether or not the signs indicate bilateral abscess formation.

That any method involving opening of the abscess into the posterior urethra entails unnecessary risk of persisting urethritis from false cavity formation.

That drainage through external urethrotomy unduly lengthens morbidity, favors the development of complicating epididymitis, and entails the unnecessary risk of a more or less persistent urinary fistula.

And, finally, that no method offers greater freedom from complications and sequelae or more certain cure of the disease than that of radical perineal dissection with posterior prostatotomy.
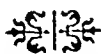
CECOPEXY AS AN ADJUNCT TO APPENDECTOMY

IN SOME OPERATIONS ON THE APPENDIX*

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THE layman of today is "appendix minded" to such an extent that he is prone to interpret any right lower quadrant pain as being due to appendicitis. The use of the phrase "chronic appendix" has been severely criticized; but nevertheless, in a large percentage of cases, no other expression so satisfactorily paints for the people of today a word picture of a pathological condition that through usage, has become not only an entity in the medical mind, but has been accepted by the layman. A great forward step has been made in the psychological attitude of the public toward operations in the past decade or two; a large number of people have been converted from a state of abject fear of surgery to a frame of mind willing to accept and even ask for an operation as a means to secure relief from a disability.

In advising patients with chronic right lower quadrant pain, the motto, "When in doubt operate," has no place until all means leading to a diagnosis have first been tried. If, for no other reason than that of the dread possibility of postoperative adhesions, obstruction of the bowel or embolism, surgery should not be resorted to unless an amount of good, commensurate with the risk involved, be almost a certainty. We cannot lightly pass up the responsibility for the removal of a more or less innocent appendix, by saying, "Well, it's out, his appendix won't hurt him now, and we didn't do him any harm anyhow." In the wave of medical enthusiasm for appendectomy as a cure of right-sided distress, the surgeon was first a leader, but now is a pessimist, holding back, wishing to be "shown." The layman is still clamoring for operation, unfortunately, and it is hard to refuse this request. The greatest steadying influence, acting as a check on a too great enthusiasm, and leading to saneness of judgment, is the quiet careful consideration of the postoperative records of patients upon whom operations have been made.

The most valuable and at the same time enlightening records are the follow-up records of the cases marked as "cured" at the time of dismissal. We all know well the many factors that make the average patient, going home after a twelve or fourteen day uneventful operation convalescence in a modern hospital, feel on the top of the wave. The advantage of follow-up records is to demonstrate which of our "cured" cases have turned out to be failures at the end of a year or two, so far as relief from the preoperative symptoms is concerned.

There is, in my opinion, no more difficult problem than that concerned with the diagnosis of chronic appendicitis. If a surgeon is honest with himself, the actual findings may be at great variance with his preconceived picture of the pathological condition. The answer as to what constitutes a "chronic appendix" will vary greatly, depending upon whether the answer is from an internist, a pathologist, roentgenologist, or a surgeon. In this paper I desire to limit the use of the phrase "chronic appendicitis" to those cases in which there is no history of acute or subacute attacks, but which come to us with reasonably consistent and definite complaints of right lower quadrant pain, soreness, distress or discomfort, perhaps some indigestion, borborygmi, eructations of gas or sour fluid, constipation, and physical findings of tenderness in the general region of the appendix. The diagnostician has had all the various special examinations made but these are either negative or inconclusive. The roentgenologist is apt to have reported that the

appendix "did not visualize on successive days' examination and during the fluoroscopic examination the region of the head of the cecum was tender on deep pressure and movable, with no evidence of adhesions." His conclusion often reads, "suggestive of chronic appendicitis due to its failure to visualize and because of tenderness in the region of the cecal head." In these very types of cases, too many times on the operating table one finds an appendix, the best excuse for whose removal is, that when removed it can no longer cause appendicitis. We have not yet reached that stage of perfection in abdominal, surgical or anesthetic technique where prophylactic operations are justifiable in the absence of pathological findings. The average time lost from the chronic appendicitis operation is about six weeks. This alone, as an economic factor, must be reckoned with.

Before going into the real subject matter of this paper, let me unmistakably express my opposition to the general principle of most ptosis operations, that is, the various types of operations that seek to rearrange the internal draping of the abdominal contents. This is a field that the abdominal surgeon investigated and discarded some years ago except in the very unusual condition and case. Many good procedures, however, that have been discarded, because an over-enthusiastic application of a principle swung the pendulum to an absurd position, we have later reclaimed and applied successfully in properly selected cases. Recently fixation of the kidney has reestablished itself for the correction of the case of ureteral kinking due to prolapse so that in nephropexy we have an operation that passed through the three periods of, "the latest fad," "in the discard," and "a present sane revival."

It is not my desire to call attention to the long list of surgical, gynecological, genitourinary, neurological and orthopedic diseases that need to be differentiated from appendicitis, or the ways and means to differentiate them; neither is the object to point out the factors leading to a diagnosis of chronic appendicitis. The reason for the paper is to report a series of cases, all very similar to the earlier mentioned hypothetical case of right lower quadrant distress that is so common in every physician's office. In this series we are humanly sure that there was no other intra-abdominal organic disease present, because of the careful preoperative examination and a thorough exploration through an adequate incision of the contents of the abdomen at operation.

To digress a moment, it is my opinion that the McBurney incision should be almost discarded as limiting the surgeon in the fulfillment of his duty to the patient upon whom he is operating for chronic appendicitis. At the end of such an operation he should be able to say to his patient and to put on record, "I looked at, or palpated the entire contents of your abdomen and pelvis, and their condition is as follows." If he merely removes the appendix through a small buttonhole incision that permits the patient to attend a dance ten or twelve days after the operation, he has very incompletely discharged his obligation as an abdominal surgeon.

And yet another digression:

The roentgenologist's diagnosis of "chronic appendicitis" has undoubtedly many times been the readily accepted salve to the conscience of and excuse for operation in the minds of surgeons because they have reported "chronic appendicitis" on inconclusive findings. I believe:

1. The non-visualization of an appendix should be a finding repeated several times before it may be accepted as evidence of disease.

2. Tenderness in the region of the cecum may not be sufficient grounds on which to base a diagnosis of appendicitis.

3. The observation of a beaded appendix or the shadow of fecoliths in an appendix is good evidence of disease.

4. The finding of an appendix shadow not freely movable because of adhesions,

or not separable from the cecum and colon is of diagnostic value.

5. An x-ray shadow of a clubbed appendix or one with the proximal end contracted and retaining the opaque substance some time after the large bowel has emptied out, is very suggestive of disease.

The drawing of a deduction of scientific value, from medical experience, is by no means a simple process. In many sciences the investigator has the power to control experience so that he can experiment; not so in medicine, for the limitation of a problem to one simple factor or one unknown quantity is always impossible.

It has been rather axiomatic in laboratory experimental work that controls be used to take account of the variables in a problem. That is particularly true in all animal experimental work. An example of the application of this principle of controls in the study of surgical problems or the surgical attack of disease in man does not appear in literature. This principle we have applied to a series of 57 cases treated surgically, and the fact that we have rigidly adhered to the principle of alternating the surgical treatment alone in these 57 rather similar clinical cases is an added reason for their presentation. In this series, the first case is dated January, 1924, and the last in January, 1929; that is, the cases extended over a five-year period ending one year ago. If this report has any value, it should be because of the end-result findings in patients so alternated and so controlled, running along simultaneously with one another and operated on by one man, under similar existing conditions over a period of years, rather than as is usual, in a series of patients operated upon consecutively compared with another series of patients operated upon during an entirely different period of time. A few years will involuntarily and unconsciously effect a distinct difference in the technique of a surgeon. Statistics are the best expression of medical experience because they are the most exact if properly prepared and compiled with skill.

The pessimism of the medical fraternity as to the cures after appendectomy in these cases of chronic appendicitis is so generally appreciated that I shall only quote a few phrases from the literature:

"The rubbish heap of dyspepsia and chronic appendicitis."[1]

"Forty per cent of operations for chronic appendicitis are a failure."[2]

"Making a diagnosis of chronic appendicitis is equivalent to a confession of ignorance."[3]

These are expressive of the opinion of many leaders of the world's medical thought. These cases we have, like the poor, always with us. Many of them cannot, even after most painstaking observation and careful consideration be satisfactorily diagnosed; neither can they be refused operation because in many of them at exploration much is found wrong, and again a fixed idea in the minds of these patients is only relieved by the operation. There is no intention to advocate the refusal to operate upon the "chronic appendix" case; but if operation is to be made let it follow most careful study of the case with the object of determining the exact condition of affairs if possible, and then at operation let an exploration be most carefully made, and a preconceived diagnosis not bias the surgeon's work. It behooves every interne and every surgeon to read the rules laid down by Charles L. Gibson, "to avoid disappointing results after operations for chronic appendicitis."[4]

Because of the general unsatisfactory experience with the end-results of chronic appendicitis operations some six years ago, we began to add the operation of cecopexy to a limited group of appendectomies. My early training had been such as to look with the greatest disfavor on all the internal drapery operations, grouping them as bordering on quackery. Thus the reason for feeling our way and performing the combined operation on only the alternate case.

In a very considerable number of patients, 10 to 20 per cent, one may find if careful investigations be made, a tendency for the right colon and cecal head to sag down into the pelvis producing a pendulous cecum. The cecum alone or the entire right colon may be so slightly fixed to the posterior abdominal wall as to be practically attached by a mesentery so that the greater part of the colon's circumference is peritonealized, thus making possible the lifting of the cecum and ascending colon out of the abdomen as much as 3 or 4 inches. This condition of right colonic hypermotility or ptosis is often present without an appreciable general visceroptosis. Such a colon becomes a "water trap," a "cess pool." In addition to the vertical excursion, which may be as much as 6 in., marked lateral motility may take place. This anatomical condition is, of course, of embryological origin, as in the final stage of colonic rotation there is normally a gradual obliteration of its mesentery by a process of fusion of the peritoneal surfaces. Of the many erratic variations from the normal process of primitive mesenteric disappearance, the most common is an abnormal motility of the cecum or cecum and ascending colon. From the standpoint of surgery the cecum and ascending colon are one. Bryant[5] found 10 per cent of 290 subjects examined at autopsy, with visceroptosis of extreme degree and only 40 per cent had no visceroptosis. R. B. Carslow[6] says the condition is found three and one quarter times as often in females as males. The onset of symptoms in these patients is usually very indefinite as it is impossible to state when ptosis becomes translated to stasis. Most usually complaint comes at or following puberty or with the beginning of regular work at a trade or job, or in another group, soon after getting on their feet after pregnancy.

The complaint centers about distress in the right lower quadrant, which is more or less constant, or worse when the individual is tired and run down or constipated. He may call this stomach trouble or speak of indigestion. Gas and sour stomach may be complained of and even food and alkalie "relief" may creep into a history. The discomfort may be general in the abdomen and flatulence is referred to frequently. Pain may be present, but is very irregular as to time of appearance and duration; it is present for hours or days at a time with intervals of freedom of such variability that the patients may be considered to be neurotic. The pain is rarely a real acute pain. A majority of these patients are of course, constipated. Their color is not good, they are asthenic, drooped, and appear of lessened vitality. The blood pressure is usually subnormal. In the women, menstrual disturbances are more common. There is a loss of appetite and loss of weight. A tendency to exaggerate symptoms with development of introspective emotional moods may become part of the picture. Irritability is often present. Upon local examination the area of tenderness is quite widespread in the lower right side. Gas crepitation may be felt under the fingers, and the abdominal wall is flaccid or at least shows no signs of muscular stiffening. The x-ray findings I have referred to earlier.

Since the beginning of this study in January, 1924 there have been 57 patients, on 27 of whom cecopexy was added to appendectomy because it did not seem that the amount of disease found about the appendix was sufficient to account for the symptoms complained of by the patient. There have been no deaths and we have had a questionnaire reply from 27. There have been 29 "control" cases from whom 27 replies have been received. The following tables summarize the two series:

		Appendectomy and Cecopexy		Appendectomy Only	
		28 Cases		29 Cases	
		27 Reporting		27 Reporting	
		0 Deaths		0 Deaths	
Age Average:		24.4		24.2	
Youngest		8		15	
Oldest		43		39	
Male:		7		4	
Female:		20		23	
Married:		6		9	
Single:		21		18	
Weight:		16 gained 81 lb.		20 gained 15 lb.	
		Average 5+ lb.		Average 3¼ lb.	
Length of operation:		35 minutes		24 minutes	
Now feeling:	Well	10		5	
	Better	13		14	
	Fair	3		3	
	No better	1		5	
Appetite now:	Excellent	20		18	
	Good	4		7	
	Fair	3		2	
Distress now:	None	17	None	10	
	Few times	3			
	Some	4	Yes	17	
	When tired menses cold	3			
Gas now:	None	17		13	
	Better	5		4	
	After starch	2			
	No change	3		10	
Indigestion now:	None	20	None	14	
	Better	5			
	Same	1	Yes	13	
	Never any	1			
Constipation now:	Better	22		8	
	Never any	4		3	
	Worse	1			
	No better			16	

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BLADDER TUMOR

A SURVEY OF FIFTY CASES*

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BLADDER tumors while extremely rare are by no means exceptional. They are more common in the male than in the female (4:1). In this series of 50 cases occurring in my private and hospital practice, and during my stay at St. Rockus Hospital, Hungary, I have tried to present the subject to the profession in the simplest manner possible. As a rule a histological specimen was examined in practically every case (90 per cent) so that not only a histological examination was made, but also a cystoscopic diagnosis of these tumors. In the final detailed report of these cases, I shall select the most interesting ones, describing not only the symptoms and the histological aspect, but also the clinical and cystoscopic interpretation of the same.

Bladder tumors for clinical purposes may be divided into three groups:

(a) Growths projecting well into the bladder. These are either papillomatous or pedunculated.

(b) Sessile growths projecting less into the bladder, spreading laterally along the bladder mucosa. Surface height in this type varies from 1 mm. to 3 cm.

(c) Infiltrating growths which invade every layer of the bladder and also surrounding bladder tissue. Infiltrating tumors always begin from surface epithelial growths, papillary or sessile, while sarcomata arise below the surface epithelium and show intravesical pedunculation or flat sessile masses on the bladder.

Histologically, bladder tumors are divided into benign and malignant. The principal benign tumor (85 per cent of all tumors) is the papilloma. Less frequently we see adenoma, fibroma, myxoma, etc. The most frequent malignant tumors are the malignant papilloma, papillary carcinoma, adenocarcinoma, and the epithelioma.

I will discuss briefly the most frequent of benign tumors, the papilloma. The use of the cystoscope with the high frequency current has deprived us of many histological classifications. In detail, the benign papilloma is always intravesical. Every malignant papilloma probably begins as a benign papilloma, the latter becoming potentially malignant in older patients at the cancer age. The benign papilloma begins as a tiny excrescence on the surface of the epithelium; an outer layer of epithelium, a core of connective tissue, and thin capillaries. It contains no muscle structure.

Malignant changes in a papilloma are as follows: thickening of the epithelial layers, multiplication of the layers, different staining characteristics of the nuclei, fusion of the papillae (two or three). The malignant papilloma is the same type of growth which invades the bladder (proper) and then is known as a papillary carcinoma. I make this distinction to keep separate the growths projecting entirely into the bladder (malignant papilloma) and the growths invading the walls of the bladder, namely, the papillary carcinoma. One of my cases (a benign papilloma) histologically and cystoscopically showed many implantations on repeated cystoscopic examinations. This is quite characteristic of malignancy, but nevertheless benign papillomata at times show the same spreading (implantation or inoculation).

Tumors of the bladder, both benign and malignant, occur in far greater frequency in the region of the trigone and ureteral orifices than in all other portions of the bladder put together.

Malignant changes are often not determined in the gross. The outstanding feature of malignancy is the thickening of the papillae, which are grayish and opaque, fusion of the papillae; and finally the

growth may be converted into a solid mass, at times appearing sessile. Malignant papillomata recur, implant themselves in

tumor, the more connective tissue we see. Oftentimes this tumor (adenocarcinoma) is called "papillary carcinoma" owing to its
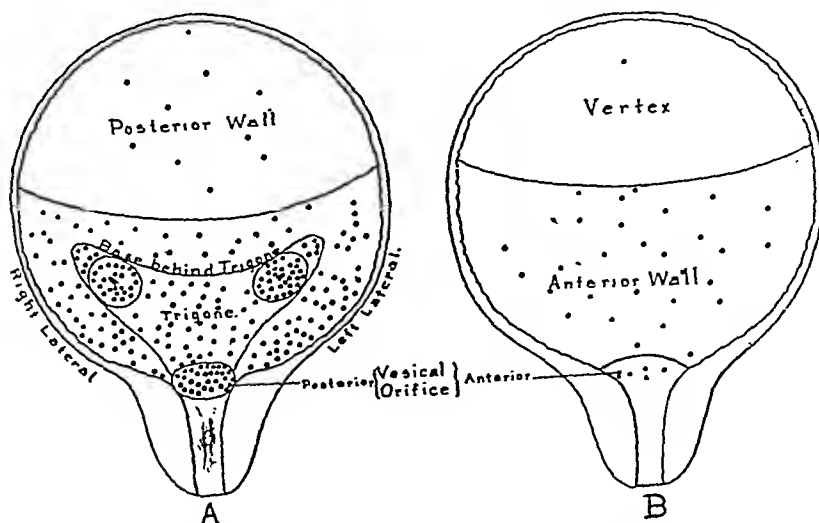

FIG. 1. Diagrammatic charts showing frequency of location of vesical tumors. Diagram prepared after careful selection of cases both of benign and malignant tumors. Note infrequency of tumors on vertex and high posterior wall, relative infrequency on anterior wall. Many at base (trigone) and ureteral and vesical orifices.

another section of the bladder, also the wound tract. Invasion of the bladder wall is not always easy to determine either at the base of the tumor or laterally. Inflammatory areola may obscure the diagnosis of infiltration in tumors, but makes the diagnosis of malignancy suspicious. Later the growth extends, encroaches on the lumen of the bladder, and irregular small thickenings may be seen on the bladder. If palpated, they are stony hard. Finally, infiltration and ulceration occur. Any type of malignant tumor may be invasive, and such a diagnosis as "invasive carcinoma" is not justified histologically.

Adenocarcinoma is rare (2 per cent). It arises from small gland groups in the bladder. Some of them resemble very closely the adenocarcinoma of the prostate; there are masses or nests of cells within which may be seen, open spaces, usually round, resembling gland lumina. The gland masses or nests are occasionally separated by thin connective tissue, fibrilla, sometimes a thin layer of dense cells. These groups of cells invade the lumen and walls of the bladder. The more invasive the

likeness to that type. In gross, adenocarcinoma is always found at the base of the bladder, near the trigone or vesical orifices. This tumor may project into the bladder, also have a thick pedicle, but it is not papillary. More often it appears flat, and the rolled-out edges give the appearance of a mushroom. I bring this point out to show that a pedunculated tumor does not necessarily arise as a papilloma. Infiltration and hardness are seen around the tumor. Ulceration is common. There is no way to distinguish the ulcerative from any other type of malignant tumor.

Epithelioma is a distinctive type of tumor. As a rule the strands of cells and tissue penetrate the bladder from the epithelium. It heaps up upon the surface of the bladder and spreads laterally. At the point of growth we see the tumor cells invading the deeper coats of the bladder. Connective tissue between the nests of cells is not thin, as in papillary carcinoma, but thick and scattered throughout. Cells (clusters) are of squamous epithelium or basal cell type. In the squamous type, the cells become larger and paler toward the

center of the nest of strands, and intercellular fibrilla (prickle cells) may sometimes be seen. Pearls (epithelial) form in the center of the nest. Epidermization occurs. In one of my cases at the St. Rockus Hospital in Hungary, epidermization was not complete, and the cells were desquamated into a central cavity, and the nuclei could be seen. Such cells break down eventually into a granular debris, different from the concentric, keratinized layer of pearls; but the picture is definite and characteristic.

Why should squamous cell carcinoma occur in the bladder? A preexisting leucoplakia or some type of irritation is responsible for the same. Occasionally in squamous epithelioma exfoliation is seen and is quite characteristic of this type of tumor. In another type of tumor the tendency to epidermization is absent and the strands or nest are solid, not differentiated, into the central and peripheral layer of cells in the strands. The muscularis as a rule in the beginning is not invaded. In gross, epithelioma is a flat, sessile tumor, projecting very little into the bladder cavity. It spreads not as papillary carcinoma, deeply, but laterally. At times it assumes a wafer or mushroom-like appearance.

Sarcoma (mesothelial tumor) is an extremely rare tumor. I have never seen one. Geraghty states that it occurs less than 1 per cent of all bladder tumors. It begins underneath the epithelium, elevates the mucosa, and then becomes a sessile growth. I have seen a papillary tumor with a short, thick pedicle (pedunculated) which was reported "sarcoma" (histologically). The diagnosis was later changed to "papillary carcinoma." The cells here in this case were spindle-like, due to the compression of the cell growth; hence the discrepancy in histological diagnosis. This fact must be borne in mind, that bladder tumors may at any time present histological changes from one type to another. These sarcomata present the characteristic histology of any type of sarcoma seen elsewhere, either round cell,

mixed cell, or spindle cell. The malignancy is determined by invasiveness, metastasis, cell changes, ulceration, etc. The tumor is
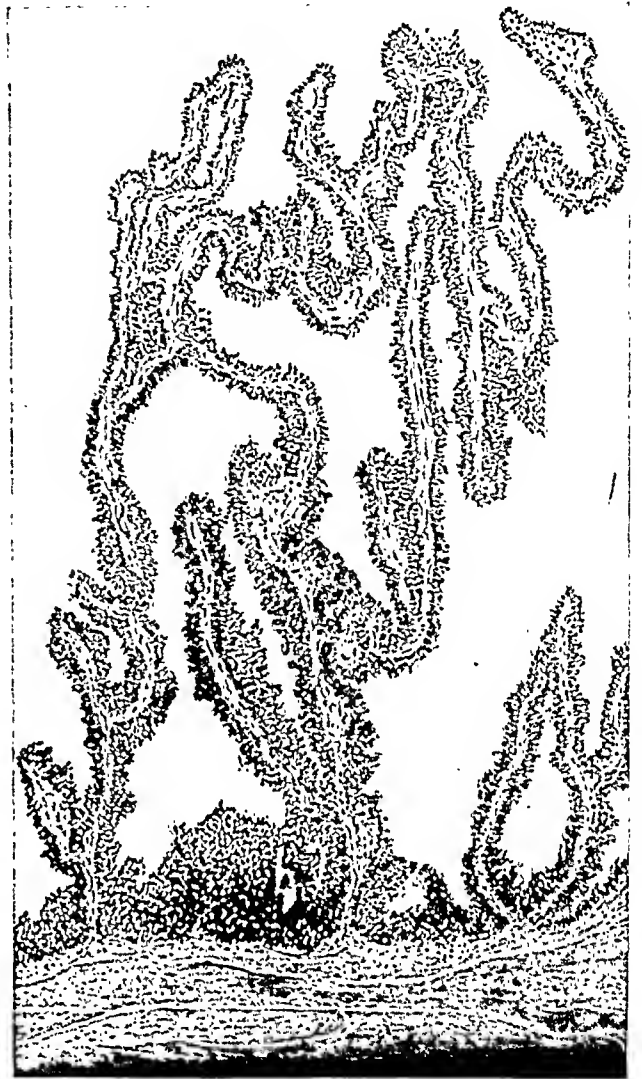

Fig. 2. Microscopical section of benign papilloma. Note uniform arrangement of papillae, and cells both central and peripheral. Various bladder layers are not invaded. Muscularis and connective tissue are normal.

apt to be confused with papillary carcinoma, as heretofore stated.

Fibroma is a rare, pedicle-like tumor; there is no infiltration or ulceration.

Of the heterotopic tumors, I shall mention only the dermoid. It is a very rare tumor; no case is reported in this series. Pieces of hair, etc., may be seen protruding from the center of the tumor. As a rule these are single.

Secondary effects of bladder tumors are manifested in bleeding, obstruction in the

ureter or urethra, necrosis, ulceration, encrustation, stone formation, infiltration of bladder wall, and infection. Bleeding is
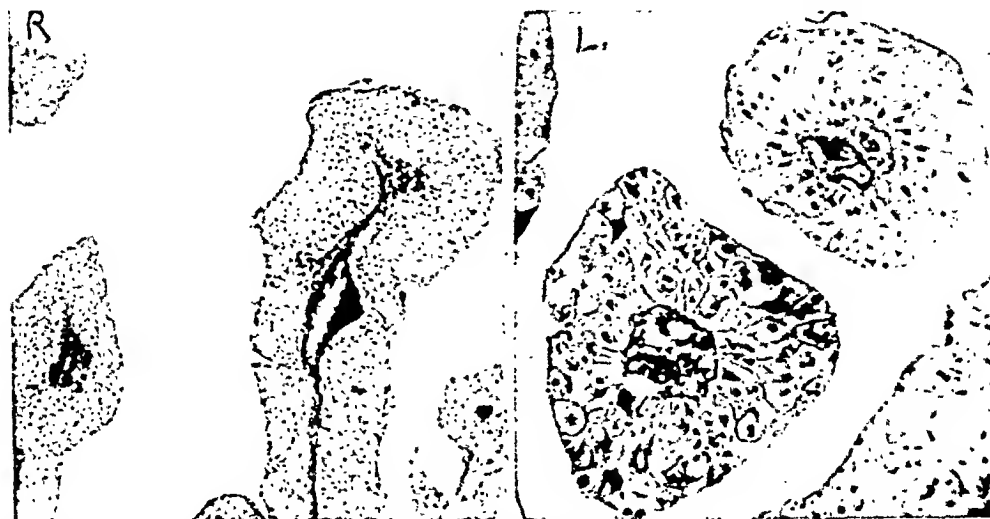

FIG. 3. *Right.* Benign papilloma of bladder. Note regular arrangement of epithelial cells and presence of basal and peripheral layers (longitudinal section). *Left.* High magnification of two small papillae. Notice uniformity of layers. No tendency to become disorganized (cross-section).

apt to be either in spurts or oozing. Obstruction is due to pressure of growth, or infiltration of growth into the urethra, ureter and rectum. Pain comes from pressure of growth on nerve-plexus. Ulceration is due to infection and pressure of cells on capillaries. There may be encrustation, due to deposition of urinary salts on tumors, or even actual stone formation. I have seen an encrustated papillary tumor which I thought was a stone. A stone searcher (cystoscope's tip) revealed the presence of a tumor, not of a stone.

Tumors may grow in a diverticulum, or start in the diverticulum and appear in the bladder cavity. I have seen one on the edge of a diverticulum. The nature of the growth was proved histologically (squamous cell carcinoma).

Metastasis as a rule is laid down in every textbook as "a late manifestation of bladder tumor." I have seen metastasis to the cervical and pelvic lymph nodes (2 cases). Oftentimes in our enthusiasm we fail to get x-ray pictures (hence the infrequency of metastasis.) Quite akin to this is the destruction of tumor by elec-

tricity, failing in this procedure to obtain histological specimens. Furthermore, the bladder itself may not be the primary site of the tumor; it may be secondary to renal neoplasm. I have seen 1 case of metastasis (implantation) from the renal pelvis to the

FIG. 4. Malignant papilloma after fulgurating (Clinic of Von Illy's, Budapest).

bladder; hence the use of the cystoscope and the x-ray. The type of tumor in the kidney (renal pelvis) most often seen is the papillary carcinoma or the benign papilloma.

I have on one occasion mistaken a blood clot for a bladder tumor. The patient's symptoms were entirely vesical; neverthe-

ment as to the proper time to examine patients with tumors in regard to bleeding. I recently attempted to cystoscope a

R.   L.

Fig. 5. *Right*. Papillary carcinoma of bladder. Large mass of tumor cells, center of which is undergoing necrosis. Process precedes ulceration, which is common in these tumors. *Left*. Epithelioma of bladder. Picture is given to contrast with one on right and illustrates much greater tendency to necrosis in epithelioma.

less I brushed away the blood clot and saw bloody urine issuing from the ureter. Diagnosis, confirmed by cystoscopy and operation, proved it to be a malignant tumor of the kidney.

Sometimes bleeding is the first and only symptom of bladder tumor; it certainly is the most frequent. It occurs in 90 per cent of all bladder tumors. It is a painless hematuria. In many of my cases bleeding was symptomless, in contradistinction to the bleeding of lithiasis or tuberculosis. Hematuria may last for three or four weeks, then stop for an interval for days or months, only to recur at a later period. The proper time to cystoscope your patient in bladder tumors is when bleeding ceases. If the patient is cystoscoped at the time of bleeding the examination is unsatisfactory. Oftentimes a diagnosis of bladder tumor can be made when so much bleeding ensues that cystoscopy is a failure.

In renal neoplasm, just the opposite, cystoscope at the time of bleeding. Very much less blood comes from your ureter than from your bladder at the time of cystoscopic examination; hence my argu-

bladder (tumor) when bleeding was excessive. It was quite unsatisfactory, but nevertheless I could faintly see the tumor. Later when bleeding had ceased I examined it cystoscopically and saw a malignant papilloma with a spurting orifice on the tip of same. Just now at this point I wish to stress the importance of the high frequency current applied rather vigorously to bleeding points of tumors. I have used it successfully on two occasions, the bleeding having ceased after its application. A recent case of bleeding following the expulsion of small stones led me astray for a short while. Plain x-rays were negative. I allowed the patient to go, but to return in one month. I then cystoscoped her. To my surprise I saw three benign papillomata. Most fortunately they were benign tumors as they all responded to vigorous fulguration. The gravel was simply coincident in this case; the tumor, I think, caused the bleeding.

Pain is generally a late symptom of bladder tumor and is due to cystitis or invasion and infiltration of surrounding nerve-plexus. Blood clots in themselves

cause a good deal of pain. The advent of pain always signifies advanced malignancy of tumors. When such a condition exists,

kidney. Disintegrated, disorganized clots mean bladder tumor as a rule.

Squamous cell carcinoma gives a flakey
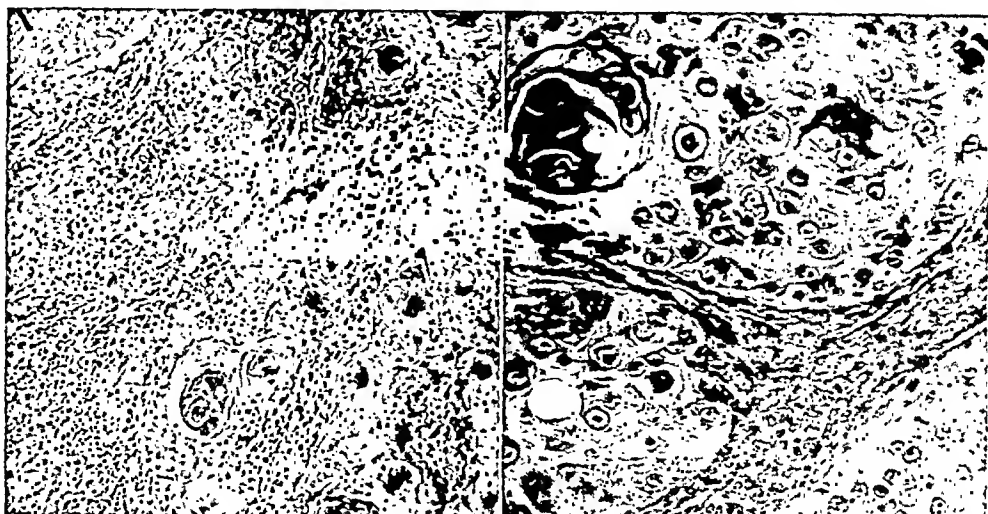
FIG. 6. *Right.* Squamous cell epithelioma of bladder (epidermoid carcinoma). The absolute typical architecture of the growth is well shown. Analogous to squamous cell epithelioma of skin. *Left.* Higher magnification of same type of tumor. The cell's characteristics and a small white pearl are shown.

radical procedure is out of the question. Occasionally advanced (ulcerating) carcinoma cannot be detected with accuracy through the cystoscope. Induration of the bladder wall as felt through the vagina or rectum is helpful.

In résumé, a bladder tumor is caused by hematuria out of a clear sky. The hematuria is intermittent. I have seen a papillary carcinoma bleed for several weeks. It was necessary to fulgurate the tumor several times before cessation of bleeding occurred. Such a symptom (bleeding) demands an early cystoscopic examination to determine the renal or vesical source of bleeding. Hematuria is never negligible; it should be investigated immediately. The cystoscope is the most valuable means at our disposal in the examination of bladder tumors. I depend entirely upon the use of the cystoscope in these cases. In flat, non-elevated, infiltrating growths, where no projection into the bladder can be seen, examine by other methods (rectal or vaginal). Worm-like clots as a rule spell bleeding from the

urine, resembling the flakes we see in leucoplakia.

Cystograms are helpful in advanced carcinoma filling the bladder, but as a rule by that time the diagnosis can be made by clinical findings alone; hence there is no real value to the x-ray in bladder tumors.

I will now attempt to divide tumors of the bladder as they occur when seen cystoscopically. In this cystoscopic division I am able to diagnose and watch the very progress of treatment in these cases. It has been of tremendous help to me in gauging the different forms of therapy. This classification may be entirely different from that of other observers, but nevertheless it has served me well. With this classification I can as a rule determine malignancy, substantiated of course by the histological examination to determine the type of malignancy. In ulcerating tumors the cystoscope will fool you; specimens must be taken. The efficacy of the various types of treatment can be gauged cystoscopically. The successful

treatment of bladder tumors depends not so much on the histological aspect of the tumor as upon the cystoscopic interpretation. Therefore, this classification I have found helpful in many cases:

(a) Papilloma, single or multiple.

(b) Papillary, non-infiltrating tumors, showing tendency to lateral spread (single or multiple).

(c) Tumors with intravesical mass (non-papillary) showing infiltration of the bladder wall and early ulceration.

(d) Low infiltrating type. No elevation or only slight intravesical intrusion.

(e) Pedunculated non-papillary do not infiltrate. They are generally benign.

(f) Sessile tumors which are non-papillary are non-infiltrating, with a question of malignancy.

Group A. These tumors are quite distinctive cystoscopically. They have a distinct pedicle (long or short), one main branch and many small, slender fibrillae extending from the main branch. The tumor simply melts away with one blast of the high frequency current. If the tumor remains distinctly globular it is benign as a rule; but if it becomes a little bit flat or sessile, with a stubby pedicle, look out for malignancy. Slight inflammatory areola suggests malignancy; it also tends to obscure hard infiltrations at times.

Group B. Papillary, non-infiltrating, showing tendency to lateral spread. This tumor constitutes a definite cystoscopical entity. It is most characteristic of all tumors as seen through the cystoscope. It comprises about 15 per cent of all bladder tumors. Just what to do for this type of tumor therapeutically has been a source of perplexity to me. There are no distinct separate papillae. The tumor is massed, the surface is irregular. The top of the tumor is apt to be soft, while underneath the top a distinct hardness is felt. It seems as though the tumor were cemented into the bladder wall. It does not infiltrate laterally in the beginning, but in a downward direction into the bladder wall. This is characteristic of this type.

I have actually seen it on two or three occasions. The edges of these tumors slope down to the bladder mucosa. This

Fig. 7. Cystogram showing irregular filling defect on right at arrow. Advanced carcinoma of the bladder. (St. Vincent Hospital, Worcester, Mass.)

type of tumor is single or multiple, generally the former, dimensions varying from ½ in. to 2 in. in diameter, and ½ in. to 1½ in. in height. Small grouping tumors scattered over circumscribed areas of the bladder may be seen. Infiltration is in a downward direction; lateral infiltration and ulceration are late signs. When ulceration does occur, it does not present the deep serpiginous ulceration of Group C, but is a superficial ulceration occupying a greater portion of the bladder. At this latter period this tumor gives the picture of Group D (to be described later). Occasionally one may see a very early stage of epithelioma resembling this picture, but ulceration is usually present in the very beginning; however, an epithelioma invades early and is usually seen in the ulcerated form described under Group C.

Group C. Tumors with intravesical intrusion (3 cm. or less), infiltrating and ulcerating.

(a) Represents any late manifestation of any previous group.
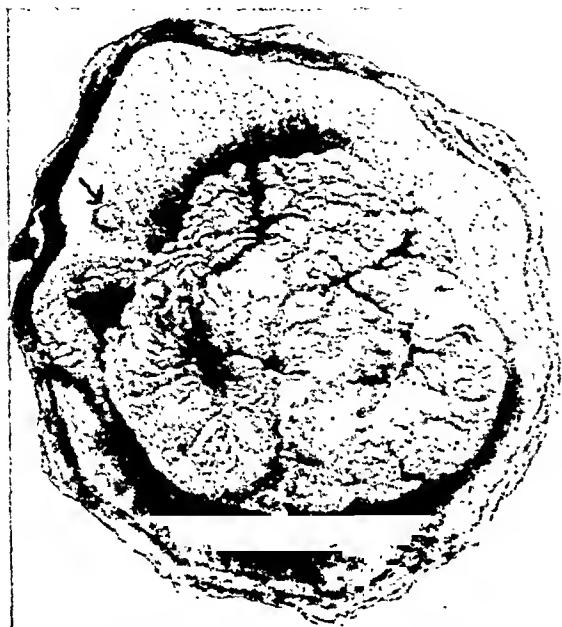
(b) Flat sessile type (adenocarcinoma

FIG. 8. Papillary carcinoma of bladder (resection). Notice invasiveness of this tumor. (Clinic of Von Illy, Budapest.)

and squamous carcinoma) may appear like Group B of the low papillary type.

Group D. Ulcerating group (late type of any previous group). These tumors cannot be differentiated cystoscopically. They show early invasion, infiltration, ulceration and metastasis.

Group E. Pedunculated tumors. These may resemble the fused papilloma (malignant). I once mistook a pedunculated tumor for a fused papilloma (malignant). The treatment is the same, fulguration. Histological specimens will clarify the situation.

Group F. Sessile tumors, non-papillary and infiltrating. Histologically benign tumors.

There are various lesions in the bladder which resemble carcinoma, viz., chronic cystitis (ulceration). Treatment suffices to clear the diagnosis. Specimens will clarify the situation.

Solitary ulcers. Specimens and treatment. The former are more important as

treatment in solitary ulcer is at times anything but satisfactory.

Tuberculous ulcers, other signs of genitourinary tuberculosis. Tuberculous germs in the urine. Pale urine. Sterile pyuria. Guinea pig tests repeated.

Hypertrophy of the prostate gland, cystoscopy, median lobe, etc. I once made a diagnosis of a median lobe for bladder tumor. A tumor presented itself with a distinct pedicle, almost the size of a hen's egg. It caused definite symptoms of prostatism. No bleeding. Residual, 12 oz. On opening the bladder a pedunculated tumor presented itself. Anatomically it occupied a position corresponding to subtrigonal glands. Histological report was masses or nests of gland tissue with lumen in the center, probably an adenoma of the sub-trigonal glands, the so-called aberrant prostate gland. It could not be definitely classified as hypertrophy of real prostatic tissue; it had no connection whatsoever to the prostate gland as the prostate occupied a position below the tumor, with a groove between the two.

The treatment of 50 cases of bladder tumor, both benign and malignant, convinces me that excision of tumors as generally carried out is not the method of choice. The high frequency current, through the cystoscope or by open operation (suprapubic) when vigorously applied even in apparently hopeless cases has worked out well. The results in the past of the treatment of bladder tumors have been so unsatisfactory in my hands, owing to many factors (late diagnosis) that any method was welcome. Radical excision or resection as generally practiced did not seem to relieve the condition, in many cases causing aggravation of symptoms with implantations and metastasis. Later on the introduction of cautery and high frequency for excisions and resections made another advance in the progress of therapeutics of bladder tumors.

Radium in the form of radon seeds, used as a adjuvant to other types of treatment, has worked to my satisfaction.

Fulguration with the bipolar high frequency current for benign growths is the method of choice for this histological type of tumor. It is also the proper method to use in excision or resection of other types of growth (malignant). Whenever possible, resect (high frequency) malignant growths; if not possible, just use the high frequency to excise. If not excisable, just do a direct fulguration with high frequency or cautery. The application of radium, as stated previously, is used only as adjuvant to other treatments. Just a word about radium. It is very much easier to plant radium through a suprapubic wound than through the cystoscope. Too large tumors should be radiated from above. The placing of radon seeds should be checked up with x-ray. On several occasions many of my seeds have not remained in situ. The seeds are removed within five days by the cystoscope, or other means available. Young of Baltimore has devised several cystoscopes for direct application of radium element. With these I have had no experience, so my conclusions would not be worthwhile.

Finally, in the treatment of malignant growths of the bladder, especially those that are invasive and ulcerative (advanced malignancy), radical treatment in such cases only tends to aggravate the condition. Palliation should be given in the form of deep x-ray therapy for the relief of symptoms and finally suprapubic cystotomy. On one occasion I attempted to attack this type of tumor with fulguration and radium. It was not well selected and the results were not good. Palliation would have served the purpose a good deal better, or possibly diversion of the urinary stream into the rectum or skin.

For the benign papillomata the treatment is one or many applications of the high frequency current. In many clinics, especially during my stay at St. Rockus Hospital in Hungary, the method of snipping them off with knife and scissors was employed.

Multiplicity of tumors (benign papillomata and malignant papillomata) as a rule requires open operation with the application of cautery or high frequency. Cystoscopic fulguration in these cases is not practical.

Tumors are handled more or less according to location. Tumors in fixed portions of bladder (most frequent position) must be treated preferably with cautery or high frequency; as a rule they are not resectable, and are malignant. Tumor (malignant) in the dome of the bladder near the anterior wall can be resected with the high frequency needle. A good rule to follow is to excise or resect with high frequency if you can; if not, just fulgurate vigorously with the high frequency current. This method necessarily demands an open operation. Radium in the form of radon seeds in the treatment of small growths (malignant) can be applied through the cystoscope. With larger and multiple growths (malignant), direct application through a suprapubic sinus is employed. I generally use platinum radon seeds, estimating my dose by the size of the tumor. I believe that the combination of high frequency plus radium works well in certain types of malignant growths. Depending on size of tumor, they may be applied cystoscopically or through open operation (cystotomy). Radon seeds are removed in three to five days, are planted about 1 cm. apart. Young applies his radium with cystoscopic applicators which are fixed in position by an adjustable screw to the table. Barringer uses practically all seeds in treatment of bladder tumors.

X-ray (deep therapy) can be used as an adjuvant to other types of treatment. It is only a palliative measure and simply relieves pain. Inoperable carcinoma, not only of the bladder but of the prostate, can be handled in this way. It seems to relieve the pain of metastasis; whether it has any curative value I cannot say.

In concluding this article, before tabulating my results in bladder tumors, I wish to state emphatically that the progress in the treatment of bladder tumors has advanced in the last fifteen years, that

TABLE I

Treatment	Papilloma	Malignant Papilloma	Papillary Carcinoma	Infiltrating Carcinoma } Adenocarcinoma } Squamous Carcinoma
Fulguration (cystoscopic). One to four applications.........	15	5	0	0
Fulguration by radon seeds (cystoscopic). One to four fulgurations. Only one application of radon seeds.......	2	6	0	0
Fulguration (suprapubic without radon seeds...........	1	1	2	1
Fulguration (suprapubic) with radon seeds...............	2	2	2	1
Radon seeds alone either with the cystoscope or suprapubically......................	0	0	1	0
Excision (suprapubic) with radon seeds...............	0	3	2	0
Resection alone..............	0	0	1	1
Other treatments such as x-ray (deep therapy), punch operations and cystotomy........	0	0	0	1
Mortality rate of all tumors 18 per cent...................	0	12 per cent	75 per cent	75 per cent
Results.....................	Excellent. No deaths. All living to date	Good. 2 deaths, 1 ten days after treatment, 1 six months afterward. All others living to date.	Poor. 6 deaths. 1 alive 3 years, 2 alive 4 years. Other 6 died within 1st year.	Poor. 3 deaths, all within 2 years. 1 living to date.

bladder tumors must be diagnosed early, and that proper medical and surgical treatment should be applied. The cessation of hematuria gives the patient false hopes, but sooner or later the bleeding recurs and the disease is beyond surgical treatment.

The bleeding of carcinoma of the prostate (which may be a little amiss here) is not too frequent a symptom. In fact, I have very seldom seen bleeding as an initial symptom of prostatic carcinoma. Not so in bladder tumor; the initial symptom (painless bleeding) requires early investigation. Better methods of diagnosis and more

careful examination of bleeding from the urinary tract (bladder) can help to a great extent the future outcome and successful therapy of bladder tumors; also a histologically benign tumor is potentially malignant at any time; the delay in diagnosis renders a condition not only inoperable, but also leaves an intolerant bladder which we are not able to cystoscope. Also, the term "essential hematuria" is a misnomer; the term "idiopathic" is much better, although it, too, is not quite appropriate.

My ideas in this article were formulated over a period of five to ten years in han-

dling this special aspect of urology; also during my stay at St. Rockus Hospital in Hungary where I was able to examine many cases of bladder tumors. In that section of the country bladder tumors seemed to be quite common. The treatment in that clinic was the same as practiced in clinics in this country. The only advance I could see was the number of surgical cases available, and various forms of local anesthesia employed. The anesthesia used in bladder tumors (benign and malignant) was caudal anestheisa plus suprapubic field-block. I was not impressed with this type of anesthesia for bladder tumors. In the higher urinary tract operations paravertebral anesthesia was used. It is a very good form of anestheisa in some cases, but not in all. I think that ether is the anesthesia of choice for kidney operations, so I conclude this article with that brief summary stated before.
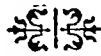
FUSION OF KNEE-JOINT*

A. DeF. SMITH, M.D.

NEW YORK

THE patient was a woman forty-eight years of age, who was seen at the New York Orthopedic Dispensary and Hospital for the first time in 1921. She then had the typical physical signs of tabes dorsalis, including contracted pupils which did not react to light or accommodation, and with absence of patellar reflexes. She was also having severe pains in both legs which were characteristic of this disease. The left knee-joint was enormously swollen and greatly relaxed, with an abnormal degree of motion laterally and in hyperextension. The joint was not painful or tender.

A brace was made which she wore for the following six years with very little satisfaction, although it did increase the stability of her knee. It was then thought best to attempt a fusion of the joint, and an operation was preformed in October, 1926. It was found that the lateral tuberosity of the tibia was entirely gone, and was represented apparently by a large, loose body. There was no vestige of the crucial ligaments and the joint was extremely relaxed. The cavity was filled with a large number of loose bodies of all sizes, many of which were in the posterior compartment. The articulation was largely gone, the articulating surfaces being covered with smooth, eburnated bone. Many of the loose bodies were removed but no attempt was made to take those from the posterior compartment. The eburnated bone of the tibiae and femur was chiseled off and some of the medial tuberosity of the tibia was cut off in order to correct the valgus deformity. The patella was removed from its bed and was mortised between the tibia and femur. The knee was immobilized in plaster for five months, at the end of which time it seemed solidly fused.

She has now been walking for about one year without support and with much greater comfort than before the operation.

It should be stated that two other similar operations have been done at the New York Orthopedic Hospital, one of which was a complete failure and the result of the other is still in doubt. It is evident that this is not a procedure which will be successful in every case.

DISCUSSION

DR. PAUL W. LAPIDUS: About two years ago, on Dr. Leo Mayer's service at the Hospital for Joint Diseases we had a similar case where an arthorodesis of the knee-joint was also attempted without however obtaining such a brilliant result. It was a case of a woman about fifty-five years old with typical signs and symptoms of tabes dorsalis and a Charcot's knee which was operated upon. A large bone graft was taken from the anterior surface of the lower third of the femur, and slid down into a bed prepared for it over the upper third of the tibia after thorough resection of the knee-joint; but the knee did not fuse in spite of an immobilization for several months. I saw her a few months ago: there was still webbling in the knee-joint which necessitated wearing a brace.

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LARGE THERAPEUTIC DOSES OF TETANUS ANTITOXIN*

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CHICAGO, ILL.

GRANT P. PENNOYER[1] states that a total dosage of 130,000 units of tetanus antitoxin was administered to his patient which is the largest he has been able to find in the literature given to a single patient with recovery. Freedlander[2] reports 4 cases, age eight to thirty-four years, receiving from 188,000 to 755,000 units, all with recovery. Most of it was given intravenously. Strock[3] gave almost 4½ pt. divided into 222 injections to 1 patient, to another 720 c.c., and to another 1400 c.c.; all 3 patients recovered. The total number of units was not stated. Bruce[4] treated 7 cases with from 100,000 to 249,000 units, one patient recovering. Woolf[5] gave 172,000 units intravenously, some intraspinally, and some intramuscularly (amounts of these not stated) with recovery. Caffrey[6] gave 112,500 units with recovery, giving some of his doses as frequently as every two hours. Young[7] gave 150,000 and 220,000, respectively, to 2 patients with recoveries. Van der Bogert[8] gave 587,500 units to a patient who recovered. MacCokney[9] also recommends large therapeutic doses of tetanus antitoxin.

The tendency now is to give larger doses of tetanus antitoxin than previously. Many of the patients, however, given extremely large doses, do not recover because of the marked severity of the infection and the greater number of days the infection lasts. There seems to be little or no evidence of untoward results from these extremely large doses of antitoxin.

The following case is of interest because of the large amount of tetanus antitoxin given with recovery:

H. S. Male, white, aged eight years, American, entered the Children's Memorial Hospital Aug. 24, 1929. On August 17, the patient lacerated his left wrist with a glass jar; the wound was 1½ in. long. At the time of injury, wound was washed with peroxide and mercurochrome; considerable bleeding ensued. On the day of admission he complained of stiff neck, fever, and set jaw. Past history is uneventful. Physical examination reveals temperature 99.2°F. Pupils react to light and accommodation but eyes do not follow objects well. Lower jaw is set with teeth 1 in. apart. Left wrist has laceration 1½ in. long which is quite dry, ragged, and red. Muscular rigidity is present throughout the body. Kernig and Brudzinski signs are positive. There is considerable pain caused in attempts to elicit these signs. Knee jerks are exaggerated, and abdominal reflexes are not elicited. Spinal fluid drawn August 27 (three days after admission) contains many pus cells. Smears of the spinal fluid contain no bacteria; blood agar plate culture made in the ward contains a Staphylococcus which is considered a contamination because the same fluid cultured in the laboratory has no growth.

Diagnosis: tetanus.

On admission of the patient 20,000 units of tetanus antitoxin were given intramuscularly and 20,000 units intravenously. The following day the patient's condition was worse. At this time 20,000 units were given intramuscularly, 20,000 intravenously, and 10,000 intracisternally. On the third day the temperature was 105°F. and swelling of the neck had increased. On this day 15,000 units were given intraspinally, 20,000 intramuscularly, and 20,000 intravenously; but none intracisternally because of a marked edema at site of the cisternal puncture. The fourth day after admission the temperature was 103°F. Muscle spasms and rigidity were somewhat decreased. Spinal fluid was under increased pressure. Temperature was 102°F. Because the patient was still quite ill, 20,000 units were given intramuscularly and 20,000 intraspinally. The fifth day, the child had muscle spasms when touched. On this day 20,000 units were given intraspinally and 20,000 intramuscularly. The seventh day (thirteen days after the injury) he was still listless and stuporous when 20,000 units

were given intraspinally and 20,000 intramuscularly. The total number of units given was 265,000.

The tetanus was accompanied and followed by several complications. A continuous fever was present from the time of admittance till September 20 (twenty-seven days). Following this an intermittent fever was present the succeeding twenty-three days. Impetigo of the face occurred on the fourth day after admission and lasted nine days. Urticaria, probably on a serum basis, developed on the seventh day and lasted six days. Furunculosis began the thirteenth day and lasted six days. Also, on the thirteenth day, diarrhea and bloody stools (enteritis) developed. The enteritis lasted eight days. The patient recovered October 16 (fifty-three days after admission).

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A NEW OPERATION FOR THE CURE OF PARALYTIC GENU RECURVATUM

A PRELIMINARY REPORT*

LEO MAYER, M.D.

NEW YORK CITY

IN 1918 Willis Campbell advocated implanting the patella into the tibia with the object of producing a bone block which would prevent hyperextension. This method I have found difficult of execution and ineffective in curing marked grades of recurvatum; it suggested to me, however, the possibility of creating a bone block strong enough to do the required work. An analogy to this type of block is found in the olecranon process of the ulna which effectually prevents hyperextension of the elbow. The purpose of the operation was therefore to convert the knee-joint into a structure resembling the joint between humerus and ulna.

Early in 1927 the first of these bone block operations was done.

The patient, a girl of twelve, had a recurvatum of more than 50°. She was completely crippled by the deformity which was so severe as to make the use of a brace impossible. The operation was done as follows: An 8-in. midline incision was made, beginning 4 in. above the patella and running down to the tuberosity of the tibia. The skin was dissected back sufficiently to expose the lateral recesses of the joint. An inverted v-shaped incision was made through the quadriceps tendon, running downward through the joint capsule on each side of the patella to within an inch of the lateral ligaments. By retracting the patella downward this incision gave free access to the joint. To give a better exposure of the upper end of the tibia, the ligamentum mucosum was divided and part of the retropatellar fat pad was excised. A 1½ in. chisel was then driven vertically downward into the tibia for a distance of 1 in. The cutting edge of the chisel was placed at right angles to the anteroposterior axis of the knee, just between the attachment of the anterior crucial ligament and the internal

meniscus. That portion of the tibia lying anterior to the chisel was pried gently forward, so as to make room for a bone graft. This was taken from the anterior surface of the femur, including a part of the cartilage-covered condyles. It measured 2 in. long, $1\frac{1}{2}$ in. wide at the distal end, $\frac{3}{4}$ in. wide at the proximal, and a little less than $\frac{1}{4}$ in. thick. With the smooth surface facing the joint (that is, looking posteriorly) the graft was driven downward into the tibia, leaving about 1 in. projecting from the upper surface of the tibia. The surface of the patella was next denuded of cartilage. It was found that the raw surface of the patella made good contact with the raw surface of the graft, thus insuring a solid union between them. The incision into the joint and quadriceps tendon was closed by continuous chromic stitches, the skin with a continuous fine plain gut. The leg was immobilized in plaster-of-Paris at an angle of 90° and kept in this position ten weeks. The operation cured the deformity and the patient is now able to walk.

Since then 11 additional patients have been operated on. In all of them the recurvatum has been entirely cured. In fact the cure was so effectual as to indicate clearly the danger of the operation, namely, the development of a flexion contracture. This can be avoided by diminishing the period of immobilization to four weeks. This has the added advantage of increasing the ultimate range of motion. In the earlier cases there was only about 40° of motion following the operation, in the last 4 cases there has been from 90 to 120°.

Another modification has been the use of a tibial graft instead of the femoral. This graft though somewhat narrower than the femoral is much easier to insert into the tibia. I have used it in the last 6 cases.

There have been no infections in this series of cases nor any postoperative complications except, (1) the formation of a postoperative hemarthros, in one patient necessitating a secondary arthrotomy to evacuate the blood clot, and (2) the development of a 20° flexion contracture due to too large a block. This was relieved by a second operation in which the upper part of the bone block was chiselled away.

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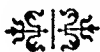
ASTRAGALECTOMY

ULTIMATE RESULT*

ARMITAGE WHITMAN, M.D.

NEW YORK

DR. WHITMAN reported the following case: A patient, a girl seventeen years old came to his clinic four days ago, stating that she was an old patient of the hospital. As he looked at her he was unable at first glance to detect anything abnormal, nor could the other members of the staff.

Examination, and the hospital records, showed that she had been operated upon by Dr. Royal Whitman in January, 1919, for calcaneus deformity due to complete paralysis of the calf muscle from anterior poliomyelitis. The operation was the typical Whitman operation of astragalectomy and backward displacement of the foot. The patient now engaged in all normal pursuits, was conscious of no disability, and was regarded by her associates as normal. In other words she presented an ideal result of the operative treatment of paralysis of the calf muscle.

Dr. Armitage Whitman said that he was particularly interested in showing the patient in view of an article by Mr. Naughton Dunn[1] in which Mr. Dunn stated that "further experience has satisfied me that this operation of astragalectomy should not now be taught or practised for the treatment of any type of paralytic deformity of the foot."

It was evident that Mr. Dunn, in common with many observers in this country, had failed completely to grasp the essential difference between the Whitman operation and any other stabilizing operation on the foot, namely:

[1] DUNN, N. *J. Bone & Joint Surg.*, April, 1930.

that after the Whitman operation dorsal flexion of the foot was checked at a right angle.

When the patient was properly trained to walk with the foot straight ahead, and to walk over the foot instead of putting it out to one side the checking of dorsal flexion endowed the foot, as the patient came up on her toe, with propulsive power. Any type of arthrodesing operation might give a satisfactory cosmetic result, but this essential and most important functional feature was lacking. Unless dorsal flexion was checked at a right angle the gait remained the same awkward, passive, clumping heel walk typical of calcaneus deformity.

This patient, therefore, presented a practically perfect cosmetic and functional result of the operative treatment of isolated paralysis of the calf muscle. Dr. Whitman stated that he thought it a sufficient tribute to the worth of any operation to be able to demonstrate that the mechanics of the operation could compensate for the loss of power of one of the two strongest muscles in the body.

DISCUSSION

DR. SAMUEL KLEINBERG: I can only emphasize what Dr. Whitman has already said. It is rather amusing to us who are acquainted with the operation of astragalectomy and backward displacement of the foot to hear it spoken of as a difficult operation and as a mutilating operation. In the hands of the experienced the removal of the astragalus is one of the simplest procedures. Any one of us can remove the astragalus within two or three minutes and complete the whole operation from beginning to end in little more than fifteen minutes. Not only is the operation fairly simple but it disturbs the structures of the foot and ankle far less than any other reconstruction operation about the ankle. In the Hoke operation, for instance, one removes the head of the astragalus, reshapes the head, removes the cartilage from the navicular bone, replaces the head, and in general one traumatizes many more structures than in the astragalectomy operation. But the most important feature of astragalectomy is not that it is a simple operation and easily performed, and not that it traumatizes the tissues far less than other reconstruction operations, but that the results can always be anticipated with accuracy. In a properly performed astragalectomy with backward displacement of the foot, one is certain that he will get a symmetrical, stable, dependable foot, and that is much more

than can be said for any other type of reconstruction operation on the foot.

I had recently a physician from Cologne visit our clinic at the Hospital for Ruptured and Crippled. He had been traveling for many weeks throughout this country and said that he had visited some thirty clinics but that in none of these had he seen the operation of astragalectomy and backward displacement of the foot performed. As the operation is well known and was evaluated by a committee specially appointed by the American Orthopedic Association to study the various stabilization operations in the ankle joint, as the most efficient procedure for stabilizing the ankle, I can only adjudge our visitor's experience on the basis that the surgeons in the various clinics he visted were ignorant of the details of the operation and its valuable permanent effects.

I am very glad that Dr. Whitman demonstrated his case before the Section. The result is unusually good. We cannot get equally good results in 100 per cent of the cases but we certainly do in the vast majority of instances.

One word of conclusion: When we think of a stabilization operation for a paralytic ankle, we must remember that of all the operations, many of which are quite satisfactory, the Whitman astragalectomy with backward displacement of the foot gives the best results, yielding in the vast majority of cases a strong, symmetrical and dependable foot.

DR. E. D. OPPENHEIMER: This astragalectomy has given a perfect result and the case demonstrates how well a patient can walk if the pelvic muscles are intact. Unfortunately most of the cases on which an astragalectomy is done have also a marked paralysis of the rest of the lower extremity, and that is the reason why this patient walks so very well and the other cases with just as good an operative result walk so badly.

DR. WHITMAN, (closing). It seems almost impossible to restrict the discussion to one subject alone. In reply to Dr. Oppenheimer's remarks on paralysis of muscles about the hip I will restate that I showed this patient as a case illustrating the treatment by the Whitman operation of isolated paralysis of the calf muscle. I thought it of interest to show how the result of an operation properly performed and given the necessary postoperative care and education, might entirely conceal the complete paralysis of the strongest muscle in the body.

AN UNUSUAL CASE OF

BREAST ABSCESS*

Gaylord S. Bates, m.d.

DETROIT, MICH.

BREAST abscess is a surgical condition of relatively rare occurrence. By far the greater percentage of cases occur in women during lactation or, less often, in pregnancy. Fleck[1] collected 430 cases from the literature and found only 5.8 per cent occurred during pregnancy. Billroth, Nunn and Bryant[2] among them collected 230 cases of abscess of the breast, of which only 34, or 14.7 per cent were unconnected with pregnancy or lactation. The sources of infection in this smaller group are as interesting as they are varied.

Velpeau[3] described a case which he saw in 1844:

. . . vast abscess of the right breast, consequent on purulent formation in the axilla which, in turn, was consequent on chillblains; [and] an axillary abscess, consequent on erysipelas produced by a blister on the left arm; incision with free drainage; abscess of the left breast; incision; poultices; cure in five weeks. [Velpeau's experience with uncommon forms of breast abscess was apparently rich, for] I have seen an abscess form beneath the mamma, consequent on the inflammation and suppuration of the perichondrium of a broken sternocostal cartilage. In many other patients the abscess has been caused by some long standing change in the subjacent ribs. In 1834, I met with an enormous submammary abscess communicating with the bronchi which followed an attack of pneumonia of seemingly mild character. In 1836, there was a woman in La Charité in whom the abscess originated in a tuberculous mass under the sternum. At the same time a young girl had one which arose between the anterior border of the right lung and the costal pleura. Pulmonary phthisis is a source of them which should not be forgotten, and of which I have witnessed many examples. I have also seen a great variety of submammary abscesses arising from various diseases of the chest in which instances, in short, they were little more than depots from gravitation.

Shield[4] reports many cases of breast abscesses where the origin could not be discovered, and speaks of the rarity of this condition in pyemia though cases are on record where such was the case, as after a recent operation or septic abortion.

Deaver[5] first called attention to those rare instances where an abscess of the breast occurs independently of lactation and in the absence of a history of trauma. These cases occur almost without exception in patients whose nipples and areolae are congenitally deformed. He quotes 2 histories of Duvergey where the phenomenon is attributed to malformation of the nipple which, being sunken, would easily become the receptacle for dust, and retain the secretions of the skin in which the microorganisms are plentiful.

Many cases have a direct and immediate relation to trauma or wounding of the breast. Fitzwilliams[6,7] reports many such cases, believing that suppuration after definite trauma, such as a blow, is due to the effusion of blood, the formation of a hematoma, with subsequent suppuration due to the lodgement of organisms in the clot. In 2 instances there was no history of trauma. In 1 case, a pure culture of staphylococcus was obtained from a breast abscess following a sore throat of influenzal origin; again, in a woman who had been in poor general condition for some months a breast abscess occurred following the appearance of several abscesses about the mouth. Davis[8] observed 1 case which followed the scalding of the breast with coffee, a pure culture of streptococcus being obtained from the abscess.

Breast abscess caused by B. typhosus following typhoid fever, is one of the rarest of complications in that disease, yet by 1915 there had been 32 authentic cases

recorded. Gerlach,[9] Schiffmann,[10] Snoke and Goforth,[11] have each reported a case since that time; and Dyke[12] has reported 1 case occurring in a typhoid carrier.

Oxley[13] witnessed a suppurating breast in which gonococci were found to be the exciting organism. This patient had a primary genital focus of three weeks' duration. The manner in which the gonococcus became implanted in the breast is not stated. According to Fitzwilliams,[6] this is the only case of its kind to be found in the literature.

CASE REPORT

CASE No. 46956, married, white, housewife, aged fifty-five, entered the surgical service of Drs. McLean, Barrett, and MacKenzie, May 5, 1930, complaining of swelling of the right breast with pain, fever, and anorexia of three weeks' duration.

About three weeks before entry the patient noticed a swelling in the left side of the neck which followed immediately on scratching an "eczema" of the left ear. Within a few days the swelling extended downward, mesially, and into the right breast which became enlarged, tender, and reddened. With this extension there was a high fever, 104°F., with delirium for nearly twenty-four hours. The family physician diagnosed erysipelas. With poulticing, 3 small patches of epithelium sloughed off just above and mesial to the nipple, and for two weeks there was a sanguino-purulent discharge from these sinuses. The fever diminished but the breast remained greatly swollen, and was painful to the least motion. Except for anorexia there were no other symptoms. About five days before entry the upper part of the right breast enlarged rapidly, and a tender swelling appeared over the right clavicle, and extended across the front of the neck to the left side. The fever increased and the patient was brought to the hospital.

Examination on admission of the patient revealed an elderly, obese female lying quietly in bed, face flushed, breathing rapidly, eyes bright, mentally clear but obviously acutely ill. The right breast, normally large and pendulous, was swollen to nearly twice the size of the left breast, the swelling extending upward into both sides of the neck, posteriorly as far

as the upper borders of the trapezeii. Over this whole area the skin was reddened, tense and hot. In the region of the nipple, were several small ulcerations filled with fibrin. Several glands were palpable in the left posterior triangle of the neck. Temperature 100.4°F.; Respiration 26; Pulse 100. Blood count: Hb 80 per cent; R. B. C. 3,150,000; W. B. C. 7650; P. 82, L. 16, M. 2. The urine showed a slight trace of albumin.

In the operating room linear incisions were made in both infraclavicular regions from which large amounts of old blood and pus escaped. Also linear incisions were made in the right axillary line and right border of the breast from which large amounts of pus were evacuated. Soft rubber drains were inserted and the wounds left open. Culture from the wound grew staphylococcus aureus.

The temperature fluctuated between 99 and 103°F. The wounds drained copiously a sanguino-purulent discharge. The patient became drowsy after operation and took fluids only by hypodermoclysis. Blood culture on the sixth day gave no growth. Death occurred ten days after admission. Permission for autopsy could not be obtained.

According to Kaufman,[14] in infectious mastitis, pyogenic organisms invade the breast (1) through the nipple, (2) through the milk ducts, (3) alongside the milk ducts through the lymph channels but in rare cases a mastitis may occur (4) by metastasis in a pyemic, usually puerperal process, or in typhoid fever, or even from the thorax (empyema, caries). This case belongs in the last category as a lymphogenous metastasis from a focus in the left auricula, extending as an acute, diffuse inflammation of the skin and subcutaneous tissues, a true phlegmon. In situations where the skin is thin a phlegmon may simulate erysipelas in appearance, a fact which led to confusion and delay in this instance.

The mammary glands are of ectodermal origin and are regarded by most authorities as modified sweat glands;[15] this, together with the knowledge that the superficial lymphatic vessels of the anterior part of the neck freely anastamose with those below

the clavicle, and that the superficial vessels on both sides of the anterior thorax freely anastamose across the front of the sternum,[16] serves to explain the manner of extension of the infection in the case described.

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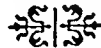
FUSION OF KNEE-JOINT

IN A CASE OF CHARCOT'S DISEASE*

MATHER CLEVELAND, M.D.

NEW YORK

A FIFTY-ONE year old negro applied for treatment at the New York Orthopedic Dispensary in November, 1928. He had a swollen left knee and limited motion, but a little lateral instability. He had a positive Romberg's sign. Voluntary sensation in the leg decreased. The pupils were irregular and sluggish. The roentgenograph showed loss of substance of the internal table of the tibial head, with condensation and disorganization of the joint, and considerable effusion and detritus throughout the joint. The Wassermann reaction was 4 plus. *Diagnosis:* Charcot's disease of knee-joint.
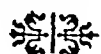
The patient was admitted to Sea View Hospital, November 19, 1928. *Operation:* Fusion of knee-joint, Hibbs' technique. Spinal anesthesia. Spinal fluid showed 2 plus Wassermann reaction; joint fluid showed 4 plus Wassermann reaction. The tissue was reported as showing chronic hyperplastic arthritis, probably of syphilitic origin.

The leg was immobilized by a plaster-of-Paris spica for two months, and then a long leg circular plaster-of-Paris splint for four months. Fusion of the knee-joint was solid at six months, and the patient went home ten months after the operation.

He now walks well, the instability of the knee is gone, and he is pleased with the result. His last Wassermann test was still 4 plus, in spite of a good deal of antiluetic treatment. This is a very fortunate outcome, which cannot be expected in every case of Charcot's disease of the knee-joint.

The American Journal of Surgery is truly independent and enters into no "entangling alliances." It publishes many papers read before the leading surgical societies of the Country, but it is *not* "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published merely because "it was read at the meeting."

⟶ E D I T O R I A L ⟵

SPECIALISTS

WITH the birth of modern surgery medicine became a complex calling. In our father's time a medical student had to cover but four or five major subjects. Two years were deemed sufficient time to launch a full-fledged doctor of medicine upon the public. It might be said the worth of a physician was estimated by the size of his watch chain, the endless number of ingredients he incorporated in his prescriptions, and whether he kept one, two or three horses going. If we believe the stories told us by those who graduated about the time of our Civil War, then medicine was a dignified profession, hedged around with ethical fences, hairs were split on minor details and an operation was truly a major event, major to both patient and surgeon. Those days have gone and whether or not the profession was on a higher scale of culture than at the present time is a matter for endless debate getting one to no definite conclusion.

However, we have the present to consider. No man can pretend to know it all. If he becomes thoroughly grounded in a certain branch of medicine he has attained enviable heights. When he confines his work to a distinct part of medicine or surgery he becomes labelled a specialist. The true background of a specialist is composed of a number of years in general practice which has given him a solid foundation in the broad fundamentals.

The public has come to look to and recognize specialists. They (the public, know no man can be expert in many branches of his work. If the profession is to keep faith with the public it must see that all who profess to be specialists are in the true sense of the word expert in a particular field. What constitutes a special-

ist? It is hard to define. In a broad sense a specialist is one who has had an ample background in general medicine, and has been specially trained by competent teachers in the many subdivisions of a division of medicine, and from years of laboratory and clinical practice under competent supervision has attained a proficiency out of the ordinary. Taking a six weeks course in some distant institution in some special work, or going abroad and wandering from clinic to clinic for a few months does not make a specialist. There are no short cuts. The road is long and the work hard and the candidate must have a natural aptitude for his tasks.

And so it is a good sign that there has been organized and is functioning harmoniously the American Board of Obstetrics and Gynecology, the aim being to determine the competency of specialists in these fields. Recognized specialists became charter members and all others are admitted after passing a satisfactory examination. Those admitted to membership have issued to them a certificate stating the holder is thoroughly competent and skilled in obstetrics and gynecology. This is no new idea. The ophthalmologists, the otologists, and the laryngologists were the first to show the way.

The state does not define qualifications for a specialist. It grants the holder of the license the right to practice medicine and surgery in all its branches. Given one with an interneship of a year in a general hospital and a place to operate—who is to judge if that man is competent to open an abdomen or remove a tumor or attempt any major procedure? There is too much needless and poor surgery done by incompetent men who are surgeons merely because they have so labelled themselves.

Other branches of surgery should follow the trail made by these special boards. By proper methods the public should be made to look for and demand that a specialist have credentials at hand to substantiate his right to the title. When this happy state is arrived at a specialist will be truly a specialist, and a great step forward will have been made to gain and retain the confidence of the present-day incredulous public.   T. S. W.
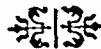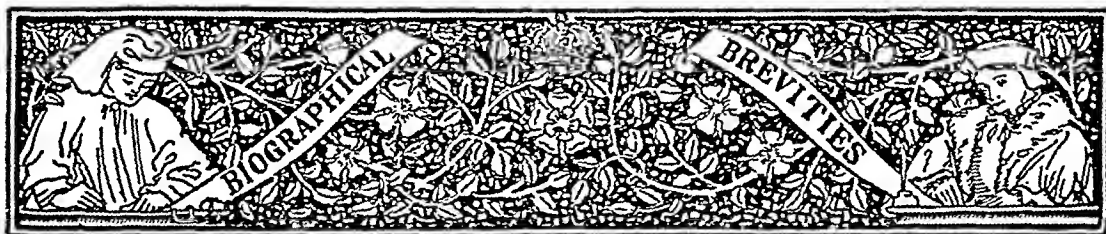
"McBURNEY'S POINT"

CHARLES McBURNEY was born at Roxbury, Mass., on February 17, 1845. He came from a family of culture and wealth. Therefore, he was given the benefits of a thorough education. As a youth he attended private schools in Boston. From these he entered Harvard from which he graduated with his Bachelor of Arts degree, in 1866. Four years later he received his M.D. from the College of Physicians and Surgeons. McBurney served his surgical interneship at Bellevue Hospital. Following this he went abroad for two years and continued his studies.

Thus well equipped to begin practice he opened an office in New York City. His first appointment was that of Assistant Demonstrator of Anatomy at the College of Physicians and Surgeons (1873). The following year he was appointed Attending Surgeon to St. Luke's Hospital. In 1880 he became an Assistant Surgeon at Bellevue Hospital. Two years later he was a Lecturer on operative surgery at the College of Physicians and Surgeons. In 1886 he received the appointment of Consulting Surgeon in the Presbyterian Hospital, the New York Hospital, and the Hospital for the Ruptured and Crippled. In 1888 he was given the position which he held for twelve years, that of surgeon to the entire surgical division of Roosevelt Hospital.

For three years he was Vice-president of the New York Academy of Medicine. He was an honorary member of the Royal College of Surgeons (England), and an honorary member of the College of Physicians and Surgeons (Philadelphia).

Although he was a surgeon of outstanding ability, widely recognized as one of the leading operators of his time, his chief claim to fame rests on an article published in the *New York Medical Journal*,[1] entitled, "Experience with Early Opera-

tive Interference in Cases of Disease of the Vermiform Appendix." Associated with this was an article appearing in the *Transactions of the Medical Society of New York*, 1891, page 208, entitled, "Discussion on Appendicitis; Indications for Early Laparotomy." The source of the eponym, "McBurney's Point," now known to every freshman in a medical school, appeared in these papers. He made the point that his "point" was the most common site of the base of the appendix. Naturally, other investigators immediately undertook work to check the accuracy of this statement. Munro and Lanz disagreed and each, in turn, attempted to anatomically designate this "point," and so we have "Munro's point" and "Lanz's point," but these have fallen into disuse with time, except in certain localities. Murphy of Chicago, while admitting that McBurney was in error emphasized the diagnostic importance of tenderness over this "point." Thus, today nothing is more common than the expression, "tenderness over McBurney's point" in the physical examination of a potential or actual case of appendicitis.

McBurney did other writing and introduced new surgical methods and instruments. In 1894 he introduced the so-called McBurney incision for appendectomy.

McBurney, a many-sided man, loved the out-doors. In his youth he rowed; later in life he took up golf, was an expert shot and fisherman. In 1892 by a gift of Wm. J. Sims the first modern operating room was established for him at Roosevelt Hospital.

McBurney married Mary Weston in 1874. They had two sons and a daughter. His wife died in 1909. His health failing, McBurney retired in 1908. Following a hunting trip in Maine, he was attacked with cardiac disease and died at the home of his sister in Brookline, Mass., on November 7, 1913.   T. S. W.

[1] Vol. 50: 676, 1889.

CHARLES McBURNEY

[1845-1913]

[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

SURGICAL AND NON-SURGICAL IMPRESSIONS FROM EUROPE*

JOSEPH K. NARAT, M.D.

CHICAGO, ILL.

THE following is not a comprehensive description of a recently made surgical pilgrimage through European hospitals (the space limits do not allow such an extensive report) but merely an informal review of impressions and observations which in the humble opinion of the writer may interest the reader; in other words, an attempt was made not to imitate a painting of old masters, complete in every detail, but rather to give an impressionistic picture with a suggestion here and there.

The outstanding feature in the medical field all over Europe is the encroachment of compulsory insurance and state medicine upon private practice. The complaints of lack of patronage are loud and bitter, on the part of the independent practitioner, in almost all countries of Europe. Denmark may serve as an illustration of the menace of socialized medicine. In this country the adult population insured exceeded 41 per cent in 1922 and 64.8 per cent in 1927.

In England every physician to whom the writer had the opportunity to talk would always touch the subject which interests him vitally, the evils of medical socialism. Attention was called to the alarming increase of excessive claims for sickness benefit under the National Health Insurance Act in effect in England. Sickness benefit claims of married women have risen between 1921 and 1927 by 106 per cent and disability benefit claims by 159 per cent. Fourteen men in every 1000 claimed sickness benefit in 1921; 23 in 1927. Physicians are in the dilemma of becoming dishonest or losing patients if not sufficiently lenient. The fears of complaints by the patients exerts a harmful effect upon the morals of our English colleagues; the laxity of certification is spreading.

The proposal of the British Medical Association to provide a nation-wide medical service stirred various comments among the English physicians. The plan is not ripe enough to permit one to form any definite opinion.

As to the illegal practitioners, Christian scientists and chiropractors are not numerous and do not play any important rôle in England.

In London the writer started where every Britisher hopes to end: in Westminster Abbey, where among other celebrities, Hunter too is buried, a beautiful example of the homage England pays to great physicians. Another example of England's respect and appreciation of accomplishments in the medical field is the beautiful monument of Florence Nightingale in

front of the Crimea Memorial in Waterloo Place, one of the most exclusive squares in London.

In the northwest corner of Trafalgar Square, one of the most popular places in London, not far from Nelson's column is a monument of Edyth Caldwell who gave her life for her country in the World War. There is a story that good women were once so rare in this vicinity that when one entered Trafalgar Square, Nelson, on the top of the column, lifted his hat and the lions surrounding the monument roared. No such demonstration happened when the writer was there.

Close by is the Royal College of Physicians occupying a beautiful building in one of the most important centers of London's life on the corner of Trafalgar Square and Pall Mall. The Royal College of Surgeons is located near Lincoln's Inn in a historical section of London. These few examples show that the medical profession in London enjoys a social prestige and prominence sometimes not so visible in our country.

It was thrilling to hear that Dr. Sloane's collection of the 18th century formed the nucleus of the British Museum.

Practically all the medical celebrities and magnates have their offices either on Hartley or Wimpole Street; the buildings occupied by the offices have a small but dignified façade and are two stories high. There are between one and five offices in each building, some of them located on the first and some on the second floor. Group practice is not popular in London.

The majority of confinements is still handled by midwives with excellent training; very few maternity cases go to the hospital, usually only if due to some abnormalities or pathology when they are referred by midwives to physicians for surgical interference.

The hospital situation is exceedingly interesting. The religious organizations manage only infirmaries, old people's homes, orphan asylums and similar institutions but not hospitals. The latter are in the majority of cases supported by the community, have a lay board of directors and depend entirely upon voluntary contributions. It was interesting to observe how such contributions are solicited. St. Bartholomew Hospital is in constant need of money and in order to raise it, it issues periodically a vast literature in form of pamphlets, circulars, postal cards, etc. A huge billboard placed on the roof of a building in Piccadilly Circus, the hub of London's traffic, says "Bart's never failed us—let us never fail Bart's." The hospital also resorts to invitations of the lay public to visit the operating rooms and unoccupied surgical wards in the just finished addition. Several nurses were encountered in various parts of the city collecting money for St. Thomas Hospital. A sign in the subway reads: "St. Thomas needs a penny a second." Garden parties frequently patronized and attended by Royalty are a popular means of raising money for hospitals. A "Living Poster" ball in aid of the Garrett Anderson Hospital was arranged in June. One of the loveliest groups in the pageant was the "Figure of Charity" with five little children clinging to her skirts. Lady Diana Cooper whose ethereal loveliness was enhanced by the severity of the nun's headdress was Charity. She is well remembered in the United States from her rôle in the "Miracle."

St. Bartholomew's Hospital is called the Mother Hospital of the English-speaking races and the cradle of British medical science. It was founded in 1123 by the Monk Rahere, formerly Henry I's court jester and occupies a part of an Augustinian priory. Henry VIII closed the hospital in order to save money, but finally was induced to reopen it; a stained glass window in the administration building shows him returning the charter. The ancient building has an indescribable charm; it from as striking contrast with the new surgical block which incorporates the latest improvements in scientific hospital construction. The corridors are heated

by steam tubes hidden in the walls. Every bed is equipped with radio ear phones. Each bed in the wards is screened and by means of washable curtains it can be transformed into a separate cubicle if so desired. There are fireplaces in wards creating a homelike atmosphere. The bedside tables have drawers which can be locked by the patient. The anesthetics are supplied through tubes from containers in the basement in order to avoid the danger of explosion. If the operating room which the Englishmen call "theater," is suddenly required for an operation, it can be warmed in five minutes by filtered air driven across special radiators by big fans. The operating room is completely bare except for an adjustable table and a short concrete pillar for the instruments needed for the operation. The instrument cupboard is outside and the observation gallery is set back in the wall and screened with glass. Set into the wall nearest the operating table are three panels for illumination of x-ray negatives, so that the surgeon may study the picture while he operates. There are day and night rest rooms for the friends of patients dangerously ill. The old administration building possesses two famous pictures by Hogarth; they alone are worth a trip to the hospital. A unique historical medical exhibit was arranged in June, 1930 in the new annex. The church across the street from the hospital is a shrine for lovers of architecture.

Another interesting institution is Guy's Hospital, built and endowed in the 17th century by Thomas Guy who made a fortune selling Bibles. John Keats, the famous poet who lived 1795 to 1821, acted as a "dresser" in this hospital.

In the Westminster Hospital Annex a "bomb room" for radium has been established. The apparatus for administration of radium is contained in this special room whose walls are lined with barium for protection in adjacent rooms. The arrangement of the apparatus permits directing the rays on two patients simultaneously.

It deserves notice that for centuries England has been taking a great pride in its hospitals and therefore prominent architects were commissioned to build new medical institutions. Sir Christopher Wren, one of the most famous English architects, who built St. Paul's Cathedral in London in the 17th century, Hampton Court, Greenwich Observatory and many other famous structures, is also responsible for the Chelsea Hospital in London.

It was surprising to hear that in many hospitals the operating schedule starts not in the morning but at 1:30 P.M. Ethyl chloride is being used extensively not only for local but also for general anesthesia for minor surgery. Mercurochrome is very little known. The use of picric acid is the routine preoperative preparation for the skin of the patient. Varicolored silk facilitates the work of the instrument nurse, various sizes being dyed in different shades.

In many older towns of England will be found semi-religious buildings of medieval date, in the form of hospitals, club houses and the like, that often possess an indescribable esthetic and historical charm. The writer had the opportunity to visit one of them, Leicester Hospital in Warwick, a beautiful quadrangular gabled building in black and white, originally a guild hall of the 15th century.

A bit of medical history in England may interest the reader. Barbers possessed from an early date a monopoly of practicing the art of surgery in the city of London and for a radius of 7 miles. In 1461 they were incorporated as one of the City Liveries Companies. In the reign of Henry VIII they were styled "Barbers and Surgeons." The surgeons were incorporated in a separate body in 1741. Apothecaries (drug stores) were originally incorporated with the Grocer's Company in 1606.

From England the way led to Holland. In the Hague Rembrandt's painting, "The lecture of Anatomy by Nicholas Tulp" was greatly admired. It gives evidence of the artist's strikingly well developed

power of observation. In this painting Rembrandt has portrayed the tendons of the flexor digitorum profundus perforating those of the more superficial flexor digitorum sublimis. In this picture the artist also demonstrated his great talent in the use of chiaroscuro or contrast of light and shade.

The adjoining country of Belgium installed telephones along the main highways for first aid at intervals of one kilometer (0.6 of a mile) connected day and night with first aid stations charged to bring to tourists within the shortest time possible, the aid they need whether on account of accident or sickness.

The next country to visit was Germany. The scope of the National Insurance can be imagined when you learn that 6,300,000 received doles in 1929. It is financed by the government and taxpayers. Health, accident, invalidism, old age and unemployment insurance are in effect. The unemployment insurance gets 3.5 per cent of workmen's pay contributed by employer and worker. The health insurance fee is 6 per cent of the worker's pay, one-third of which is paid by the employer. Of twenty-two millions insured 11.6 per cent underwent medical treatment in one year. For accident insurance the employer pays 2 per cent of his worker's pay. The increase of sickness claims due to the Compulsory Sickness Insurance in 1929 was 70 per cent over 1924.

Regarding the professional fees a few examples will be sufficient to form an idea how underpaid the German physician is. For setting a fracture he is paid 15 marks (1 mark equals approximately 25 cents) and he is entitled to charge 60 pfennings (15 cents) per each day of after-treatment. For an abdominal operation such as appendectomy he receives the fee of 50 marks and 60 pfennings per day. For a confinement he is paid 50 marks. Of course x-ray pictures and anesthetics are paid for extra; also an additional small fee is paid for distance to the patient's home. A question was asked, what prevents the patient from consulting the university professors even in case of trivial ailments as long as the insurance company pays for it. The explanation was given that the patients frequently dislike to consult the professors because instead of getting personal attention they are turned over to the assistants. It is by no means a rare occurrence for the sisters who manage the hospital to appropriate the professor's fees for the general hospital fund. Positions in hospitals being highly desirable on account of the wealth of material, the physicians are inclined to overlook such "mistakes."

It was edifying to learn that group practice is forbidden by the Krankenkassen (sick benefit associations) because it creates an unfair competition.

Another interesting feature is the establishment in Prussia of an occupational tax levied on physicians. The way the problem of abortions is handled in Germany is very instructive. No fees whatsoever may be charged for a curettage performed on account of an incomplete abortion. Therefore such patients are usually directed by the physicians to charity institutions. This rule is an attempt to curtail illegal abortions performed by physicians.

It was noted that the majority of German Hospitals have x-ray departments which are larger and better equipped than ours; the surgeons are better trained in the interpretation of radiograms and are usually present at fluoroscopic examinations instead of depending upon the written report. Instead of the deplorable indifferent attitude or half-hearted support we find a great interest for radiology among the surgeons.

In Germany as well as in England ethyl chloride is extensively used for general anesthesia and is not regarded as dangerous if used a few minutes only. The new anesthetic avertin enjoys an enormous and steadily-increasing popularity. As it is relatively little known in the States a few words may be said about it.[1]

[1] The reader is referred to the July, 1930, issue of THE AMERICAN JOURNAL OF SURGERY, Ed.

Avertin or tribromethanol synthetized in 1923 by Willstaetter and Duisberg and investigated pharmacologically by Eichholtz in 1926 has been used in over 150,000 cases reported in the current literature; it seems that we have acquired in it a valuable new anesthetic. It is employed in the form of a 2½ per cent aqueous solution of avertin fluid and the amount so calculated that the dosage is 100 mg. per kilogram of body weight. The solution is tested before it is administered by adding to 5 c.c. of avertin solution a few drops of 1:1000 aqueous solution of Congo-red; the resulting color should be a clear orange-red, without any violet or bluish tint, the latter indicating decomposition. Thirty minutes before operation the solution is introduced into the rectum. It does not produce local irritation unlike other rectal anesthetics. In from ten to fifteen minutes after the injection sleep occurs without a preliminary stage of excitement. In the majority of cases there is no nausea after the operation; another welcome feature is the postoperative amnesia. The patient has no recollection of anything that happened. A supplemental anesthesia, whether general or local, is required in about 75 per cent of cases, but the quantity of inhalation anesthetic is substantially reduced. The outstanding feature of this remarkable agent is the production of unconsciousness without the patient's being aware that an anesthetic is being given. The preoperative anxiety and apprehension of the surgical patient are thus eliminated. It is applicable in pediatric practice. The main contraindications are severe organic diseases of liver and kidneys, acidosis, advanced pulmonary tuberculosis and ulcerative processes of rectum and colon; also obese, debilitated and elderly patients. It is especially well tolerated in hyperthyroidism and therefore extensively used in operations for toxic goiter. It is an excellent basic anesthesia, that is a primary means of inducing unconsciousness, to be supplemented if necessary by some other general spinal or local anesthesia. It represents a valuable contribution in the field of general anesthesia and deserves special attention in cases of exophthalmic goiter, in pediatric and obstetrical cases.

The administration of inhalation of carbon dioxide at the termination of general anesthesia is much more popular in Europe than in the United States. Recently, Henderson recapitulated the benefits of inhalation of carbon dioxide; it effects a restoration of the alkali carbonates in the blood and carbon dioxide contents of the blood. The deep breathing induced by inhalation of carbon dioxide is effective in preventing and overcoming postoperative pneumonia which sometimes develops from atelectasis.

It has been gratifying to learn that Hamburg has named a street after the late famous dermatologist, Professor Paul Unna.

In Bonn in the University Clinic of Professor von Redwitz avertin is being used in every goiter operation. In gastric ulcers resection is given preference to gastroenterostomy.

In Heidelberg the same nurse has been in charge of the operating room for twenty-one years. Such incidents explain why team work in European clinics is so excellent. In the institute for Cancer Research in Heidelberg Professor R. Werner reported favorable results from autohemotherapy, i.e., injection of the patient's own blood around the tumors in the treatment of superficial cancers.

In Berlin in the University Clinic Professor Bier uses blue operating sheets claiming that they do not hurt the eyes as much as the white ones. This master surgeon possesses no dramatic quality but is careful and conscientious in his surgical technique. Bassini's method is the operation of choice for herniotomies. Avertin is being used extensively.

Professor Sauerbruch in the Charité has an enormous operating room; the floor is blue, the walls are tiled in pleasing gray and blue hues. In his clinic as well as in the majority of other German hospitals,

rubber aprons and wide rubber shoes are worn by the surgeon and his assistants at every operation. In exophthalmic goiter and in pediatric practice, 1 per cent thymol spiritus colored with eosine is used instead of iodine for skin disinfection. Sauerbruch uses avertin extensively. Silk is preserved in a mixture of 1 per cent camphor oil and 96 per cent alcohol. Catgut is kept in the following solution: iodi puri 1.0; paraffini liquidi 30.0; benzini, 1000.0. Mastisol is used for dressings instead of adhesive plaster or collodium. This mixture is prepared in the following manner:

Mastix...... 20.0 (1 heaping tablespoon)
Chloroform.. 50.0
Linseed oil...   gtt xx

Kirschner's pin is very popular for extension in fractures of long bones. After the operation, the patient's bed is wheeled into the operating room and the patient transferred from the table directly to his bed. In the surgical clinic of the Charité each floor has balconies occupying the entire length of the building, thus giving the patients the benefit of fresh air.

In Tempelhofer Feld which is the largest flying field in Europe, the writer witnessed army exercises in transportation of wounded soldiers by aeroplanes.

Nearby is St. Joseph's Hospital, the last work in hospital construction. Each floor has open verandas communicating with every room so that the patient can be shifted there in his bed without any difficulty; the courtyards are surrounded by arched cloisters and have beautiful flower beds. There are flower boxes in front of every window. In the operating room a high stool with a top in form of a bicycle seat was noted. It is customary in Germany for the surgeon to sit during prolonged operations, a habit worth while imitating as it prevents formation of varicose veins and physical strain.

In Dresden in the new children's hospital every room has a door leading to a terrace; it exemplifies the great attention paid in Germany to fresh air in postoperative treatment. The International Hygienic Exposition was visited. It had been advertised on huge billboards all over Europe. One interesting feature was a stage which has been made to serve hygienic teaching. A drama entitled "The Tragedy of the Physician" enlightens the people as to the nature and treatment of cancer. The international health service of the Hygiene Museum has prepared a traveling exhibit installed in an autobus which will be shown in rural districts. Models, lantern slides, charts and films will be utilized. A large tent is carried for the protection of the exhibit and the audience.

In Munich the palatial hospital in Schwabingen was visited. Although the pavilions are twenty years old the immaculate cleanliness creates the impression that they are brand new. The courts are surrounded by arched corridors and filled with linden trees and flowers. This institution as well as St. Joseph's Hospital in Tempelhof in Berlin should not be omitted by any person who is interested in hospital construction.

In Oberammergau, where the famous passion plays are played, the children's hospital is called Hansel and Gretel House; the front of it is decorated with paintings representing scenes in the charming fairy tale.

From Germany the way led to Prague. A visit to this old city is a delight filled with interest. The people are charming and most cordial. Prague has two universities: Czecho-Slovak and German. Professor Jirasek is head of the department of surgery of the Czecho-Slovak University. He speaks English fluently. While watching his operations one is impressed with the swiftness and gentleness which bespeaks a perfect knowledge of anatomy, pathology and a mastery of technique. The majority of herniotomies are performed under spinal anesthesia. The skin is sutured with curved needles. The surgeon sits while performing the operation. Kirschner's pin is in use for treatment of fractures of long bones.

In comparison with many of our hospitals much greater attention is paid to after-treatment of fractures; the clinic is equipped with devices for baking, Zander's apparatus, quartz lamps, etc. Jirasek does not inject one varicose vein at a time but hospitalizes the patient, injects all the veins at one time and ligates the saphenous vein; he uses either glucose solution or sodium chloride. For gastroenterostomy he uses interrupted stitches; silk is the sewing material.

Professor Schloffer is the head of the department of surgery of the German University in Prague; he also speaks English. An opinion of the wealth of material can be formed when one learns that an average of 20,000 patients a year visits the dispensary of his clinic. Spinal anesthesia and avertin are the anesthetics of choice in the majority of operations. He favors resection of stomach in gastric ulcers. Mastisol mentioned before as being used by Sauerbruch is also popular for dressings in Schloffer's clinic. He also uses Kirschner's pin in treatment of fractures.

From Czecho-Slovakia the pilgrimage brought the writer to Vienna. It was pleasing to hear that Vienna erected a monument to the late Professor Clemens Pirquet. The most amazing sights in Vienna are the new houses for people of small means. The building program of the municipality has provided the city with 60,000 new dwellings. Shabby slums have been replaced by huge structures admitting light and fresh air in abundance and providing standards of order and cleanliness. The rent for an apartment consisting of four rooms is $3.00 per month and includes gas and electric light. A separate building usually located in the center of a large courtyard contains a laundry and a bathing establishment with bathtubs, showers and swimming pool; also a kindergarten and a library. The laundry has the newest equipment including electric washing machines, wringers, mangles and drying rooms. The use of laundry and baths is either free or a ridiculously low nominal fee is charged for it. In some of these dwellings a central kitchen provides meals for all who wish to avail themselves of its service. This successful attempt of the Vienna municipality to solve the housing problem excites deep admiration.

The surgical clinic of Eiselsberg in the Allgemeines Krankenhaus does not look attractive from the outside but the wealth of material and the reputation of the staff are known to the medical profession all over the world. Only a few points will be mentioned as it is impossible in a short description to give a complete report of all the impressions. The bottoms of the pails in the operating room are provided with rubber discs in order to prevent noise. The sewing material is wound on colored reels facilitating the selection of the proper number by the nurse. Mitchell's clips are being used extensively. A drain for thyroidectomies is made up out of a few braided wool strands. All the operations for toxic goiter are performed under avertin, eventually supplemented by nitrous oxide or procaine. Splanchnic anesthesia and Pitkin's method of spinal anesthesia are being used in abdominal surgery. However, local anesthesia is much more popular than in the majority of the American hospitals; for example, the writer witnessed a resection of the upper jaw for cancer under excellent local anesthesia. In callous gastric ulcers resection is the operation of choice. Mastisol is being used for dressings. In gastroenterostomy the suturing is made with curved needles; catgut is being used for the mucosa and silk for the other layers. After the operation the patient is transferred not to a cart but to his own bed rolled into the operating room.

After Austria, Italy was visited. In Rome, the Policlinic, a combination of very attractive modern buildings affiliated with the university, occupies several blocks. The distinguished Italian surgeon Bastianelli retired on account of age, and Professor Allessandro became the director

of the surgical department. The clinic is one of the relatively few hospitals in Europe where ethylene is being used for anesthesia. In the preparation of the surgeon's hands for operation scrubbing with soap and water is omitted entirely and substituted by the use of 70 per cent alcohol for ten minutes; after that, the tips of the fingers are dipped into tincture of iodine.

In the basement of the Capucine Church in Rome, an odd collection of bones was visited; it occupies several rooms. The monks arranged the bones of their deceased brethren on the walls and ceilings in fantastic manner. Even the chandeliers are made out of real bones.

In Florence a foundling hospital was created in the 14th century; the generous philanthropist not only gave sufficient funds to build the hospital but endowed it with such a great sum that the institution still manages to be self-supporting. Famous medallions by Andrea della Robbia, representing bambinos, i.e., infants in various poses, decorate the exterior walls of this hospital.

The last stop of the tour was Paris. After Professor Tuffier, one of the most prominent French surgeons, expired, his chair of surgery was offered and accepted by Professor Cuneo. Hôtel Dieu, one of the oldest hospitals in Paris, affiliated with the medical school, occupies an enormous quadrangular building with an open court surrounded by charming arcaded galleries. Bassini's operation is the method of choice for herniotomies. In abdominal surgery, chloroform is still occasionally used for anesthesia. However, it has been replaced largely by spinal anesthesia. Otherwise nothing was noted that differs greatly from our technique.

If it is permissible to summarize the impressions and emphasize the points which made the greatest impression upon the writer, the following may be said.

1. A general apprehension among the medical fraternity in Europe on account of state medicine. A growing dissatisfaction with the conditions created by the compulsory health insurance.

2. Excellent surgical team work, explainable by the fact that the surgeon, his assistants and nurses work together for many years.

3. Extensive use of the new anesthetic avertin.

4. Popularity of Kirschner's pin in the treatment of fractures of long bones.

5. Emphasis laid upon fresh air in postoperative management of surgical patients.

6. Close cooperation between surgeons and radiologists; excellent equipment of roentgenological laboratories and good training of surgeons in interpretations of radiograms.

BOOK REVIEWS

TAIT MCKENZIE. A Sculptor of Youth. By Christopher Hussey. Phila., J. B. Lippincott Co., 1930.

Leonardo da Vinci was primarily an artist and sculptor. His interest in anatomy was developed as an auxillary to his artistic work. McKenzie's technical training reverses that of Leonardo da Vinci in that it was that of an anatomist and his artistic development had as a background his knowledge of human anatomy and remarkable opportunities to study the human form in action as Director of Physical Education at McGill and the University of Pennsylvania. As Hussey says, "Probably no man filled with the aesthetic impulse has, since the days of the Greeks, seen pass before his eyes so long and varied a procession of men in the nude as he has during the physical examinations that he has conducted for the last thirty years." Hussey divides McKenzie's artistic career into two parts; the first deals with the years in which he was almost entirely

occupied with the sculpture of the athletic form in action. The second part takes up his work since the Great War, much of it consisting of War Memorials but including also much valuable work on other lines, especially as influenced by the Great War. The division is a good one because in the nature of events that historic episode marks a sharp differentiation in its characteristics.

The son of a Scotch minister of a small parish in Canada, McKenzie after completing his school years entered McGill at the age of eighteen and worked his way through the subsequent years of his university life, graduating in medicine in 1892. When he began his studies at McGill his lack of physical development barred his way to participation in athletics. This handicap he overcame by serious work at self-development until by the end of his second year he had won the All-round Gymnastic Championship and before graduating played on the football team and won the Inter-Collegiate High Jump Championship. The work which he did in the perfection of his own physical development was to prove of great value in his subsequent labors towards the regeneration of others.

In 1891 McKenzie was appointed assistant instructor in the gymnasium at McGill, and the following year was given entire charge of physical education at the University. In 1894 the post of Medical Director of Physical Training was created and the position given to him. A few years later he became Demonstrator and Lecturer on Anatomy in the Medical School. All of the work of these years moulded his artistic development. In 1900 McKenzie first turned his attention to modelling and shortly afterwards brought forth his first notable artistic achievement, the four masks of the face showing its expression in Effort, Breathlessness, Fatigue and Exhaustion. Following this initial success McKenzie began his work as a sculptor in the round and produced "The Sprinter," which was hailed with acclaim by the artistic world, and at once established his position in sculpture. It is impossible to describe McKenzie's continuous series of triumphs in the depiction of the athletic form both in various forms of action and in repose. The statues and medals of the years which followed have most of them been reproduced in such numbers as to render the majority familiar to all.

In 1904 McKenzie accepted the position of Professor of Physical Education in the University of Pennsylvania which he has held until the present year. In Philadelphia there may be seen several notable examples of his work in another field than that of athletics, statues such as those of Benjamin Franklin and Dr. Edgar Fahs Smith.

With the Great War came new opportunities. McKenzie got leave of absence from the University and going over to England received a commission as a lieutenant in the R.A.M.C. It was not long before his special gifts were recognized and he was put on the staff and assigned to the special duty of organizing methods for improving the physical condition of recruits and giving remedial training to men who had been rendered unfit during army service. Naturally in a book dealing with the artistic aspects of his life McKenzie's invaluable army service is not given the extended attention which it merits. He was later transferred to Canada for the same kind of duty, and when the United States entered the War his services were utilized by its government. During his army service McKenzie came in close contact with many new aspects of life and in 1915 he modelled the figure of a Scotch soldier "Blighty" which has won well-deserved popularity. This was the first of the war sculptures and it has been followed by many. In England, Scotland, Canada and the United States are many striking memorials in all of which McKenzie manifests the depth of feeling, catholicity of interest and fine instinct which renders them of such wide appeal. We cannot attempt to enumerate them in the space of a review. Hussey has studied them and the reproductions in his pages bring them vividly before us.

This book is a splendid tribute not only to the artist but to the man who is its subject. It is given to few nowadays to touch life and achieve distinction in so many aspects. Our profession may well be proud of the achievements of one who while perseveringly attaining distinction by his distinctly professional work has won for himself immortal fame as one of the most eminent sculptors of his day. Mr. Hussey's book is delightfully written and copiously illustrated with excellent reproductions of McKenzie's work.

DIAGNOSTICS URGENTS. By H. Mondor. Paris, Masson et Cie, 1930.

One of the most important problems that faces the practitioner of medicine from time to time is the problem of the so-called acute abdomen. What is going on back of that tender, rigid abdominal wall, and when should the patient be operated on? Will it be safe to watch for a few hours with the hope of making a better diagnosis? It is interesting to see that a volume of over 800 pages can be written on this subject alone. The book is well and interestingly written. It is well illustrated and it might with advantage be added to the library of every surgeon who can read French. It is a book which might well be translated into English. It appears to have been written by a man who has really had some experience and who personally knows something about his subject.

ANAESTHESIA AND ANAESTHETICS. By F. S. Rood, M.B., B.S., and H. N. Webber, M.A., B.CHIR. 277 pp., 56 illus., N. Y., William Wood & Co., 1929.

To those who are curious to compare our methods of anesthesia with those in vogue in University College Hospital, London, this book is recommended. Our accomplishments in general narcosis, as well as in regional, including subarachnoid block (spinal anesthesia), have been so rapid and varied, that few nations have been able to keep pace with the progress made in the United States, in less than a decade.

GENERATIONS OF ADAM. By A. L. Wolbarst, 355 pp., N. Y., Newland Press, 1930.

Here is an unusual book, i.e., a book about sex written without reference to the theological or moral aspect of the subject. True enough considerable discussion of both is present as explaining the false attitude of the general public to the important question which lies at the bottom of all life.

However sensibly and naturally the subject of sex may be dealt with by primitive people, the fact remains that in most of the so-called great civilizations the question has been unmercifully distorted both by so-called moralists and by the theologians. The present-day attitude of most American people is that sex and all reference to it is "dirty." Prominent Senators work themselves up into a frothy rage over books dealing frankly with the subject and most such books are on an *index expurgatorius librorum prohibitorum* and are not allowed free entry through the chaste parts of the country, albeit all of them may be bought freely in towns where there is more than one bookstore.

It is, therefore, refreshing to review a book in which the question of the relations of the two sexes is discussed from a biological viewpoint or as it really is rather than from that of the people who would like to have it as they think it should be. The author has done a good piece of work and all those interested, such as teachers, parents and social workers, would do well to read it, while members of all legislative bodies should not fail to do so.

It takes courage to put a book like this one out in "moral" America, and it will not be strange if the reformers and censors get after it, which would, of course, be just the advertising that it requires. A book as good as this one deserves widespread publicity and a brush with the vice hounds would help it a lot.

J. R.

DAS ULCUSPROBLEM IM LICHTE MODERNER RÖNTGENFORSCHUNG. By Priv.-Doz. Dr. H. U. Albrecht. Leipzig, Georg Thieme. 1930.

Dr. Albrecht has made an interesting statistical analysis of some of the problems of gastric and duodenal ulcer. A few years ago the Germans thought we, in America, were all wrong in our conviction that duodenal ulcers are much more common than gastric. It is interesting to see now that at least in Frankfort they are finding 5.8 duodenal to one gastric lesion.

The part of this book which interested the reviewer most was the discussion of gastritis. Albrecht uses the beautiful technique of Berg in which small amounts of the thick suspension of barium are put into the stomach. The films so obtained are beautiful and show a wealth of detail. Some of them show a thickening of the folds of the mucous membrane which probably has significance. The book deserves a place in the library of every earnest roentgenologist and gastroenterologist.

PRINCIPLES OF
PREOPERATIVE & POSTOPERATIVE
TREATMENT

BY

REGINALD A. CUTTING, M.A.,PH.D.,M.D.,C.M.

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PRINCIPLES OF PREOPERATIVE
& POSTOPERATIVE TREATMENT

CHAPTER III

THE GENERAL POSTOPERATIVE CARE OF THE AVERAGE "GOOD RISK" LAPAROTOMY PATIENT

The immediate care of the postoperative case naturally concerns itself with the removal of the patient from the operating table and his return to bed in the ward or the room to which he has been assigned. It is assumed that the operative procedure is not complete until the dressing of the operative wound has been performed and the operating surgeon has indicated that the surgical seance as such is at an end.

Usually the patient is, of course, still either completely or partially under the influence of the anesthetic agent used during the course of the operation, whether local or general, and is in no condition to take care of himself.

The operative wound from this time forward should, in all procedures involving the manipulation of the patient, be treated with the utmost respect. When lifting, turning, or otherwise moving the patient stresses and strains on the suture-line should be scrupulously avoided.

I. POSTOPERATIVE CARE BEFORE THE REMOVAL OF THE PATIENT FROM THE OPERATING TABLE

A. EARLY TOILET OF THE MOUTH AND THROAT: The first consideration which arises in connection with the earliest care of the case involves attention to the respiratory and upper intestinal tract. Such cases as have been or are still under the influence of a general anesthetic require immediate care of the mouth and throat aimed at the mechanical removal of masses of foreign material which may have accumulated therein. The irritating influence of ether vapor makes itself felt in excess

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formation of mucus and saliva, and frequently considerable conglomerations of such material, sometimes mixed with vomitus, become lodged under and around the tongue and between the jaws and the cheeks. If this material be not gently swabbed away, the swallowing reflex being still in abeyance, aspiration of the mass, or parts of it, may ensue, and the development of respiratory infection be thus favored. Probably the aspiration of some infected material in this manner during the entire course of the anesthetic period can hardly be avoided, and the relative infrequency with which pulmonary infections, which can truly be called aspiration pneumonia, develop postoperatively is an indication of the natural resistance to such infection normally present. In case the patient has vomited during the course of the operative procedure or begins to do so during the period of beginning return to consciousness there is an especial indication for care in connection with the mouth and pharynx, the removal of vomitus.

The removal of mucoid secretions or vomitus which have already found their way into the lower respiratory tract is not so simple a matter. Cases may frequently present urgent indications for such removal, however, as evidenced by considerable cyanosis, hyperpnea, and coarse tracheal and bronchial râles. A method which has proved of value, especially in cases in which the cough reflex is not in abeyance, is the treatment by postural drainage, a method which is commonly practiced in connection with the drainage of lung abscesses and bronchiectases.

The head and shoulders of the patient are gradually lowered, or, what amounts to the same thing, the feet are gradually lifted, until there is a considerable inclination of the body toward the head; the latter is then turned to one side, and the patient, if conscious, is encouraged to cough. Five minutes in such a position will usually prove of remarkable value in ridding the lower respiratory tract of accumulations of fluid and mucus.

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In the severer cases several repetitions of this procedure at intervals of two or three hours are indicated after the patient has been returned to bed.

B. GASTRIC LAVAGE: The advisability of performing gastric lavage should now be considered. Most of the excess secretions of the upper respiratory tract resulting from the action of the anesthetic, and also vomitus, are either expelled from the mouth or are swallowed into the stomach. The presence within the lumen of the stomach of such material is undesirable from the point of view of bulk, from the point of view of the nature of the substance itself, and from the point of view of its anesthetic vapor content. Accordingly, many surgeons believe that a prophylactic cleansing of the stomach should be made a routine matter at least in cases of general anesthesia and habitually practice it as soon as the immediate toilet of the oral cavity has been completed. These authorities believe that thereby postoperative vomiting is minimized because the irritative action of the stomach contents is obviated.

In cases in which gastric lavage is practiced in accordance with the theoretical considerations large quantities of more or less tenacious, stringy, mucoid material, laden with the vapors of the anesthetic agent, are commonly recovered. The routine performance of gastric lavage, however, is not by any means universally practiced.

1. *Special Indications for Lavage:* There are, nevertheless, three different types of cases in which for relatively obvious mechanical reasons the institution of gastric lavage may be particularly indicated.

1. The cases in which preoperative treatment has been inadequate.

2. The cases in which inhalation anesthesia has been induced or maintained with difficulty, and the patient has coughed, struggled, choked, and vomited.

3. The cases in which the stomach or upper intestinal tract has either been obstructed preoperatively or has been the object of direct or indirect surgical attack during the operation.

In the first type of case lavage is advisable particularly in those cases in which food has been given only a short time

before operation and the gastrointestinal tract is, therefore, more or less burdened with the products of incomplete digestion. It must be remembered that in such cases during the administration of most anesthetics a condition of reverse peristalsis is prone to occur in the upper small intestine with regurgitation of succus entericus into the stomach, so that even though the stomach was previously empty, it becomes filled again; furthermore, subsequent to the operative procedure a relatively long period of intestinal quiescence ensues, due to paralysis of intestinal movements, especially in ·those cases in which the abdomen has been opened, and intra-abdominal trauma has been considerable. Material regurgitated in the manner described, therefore, tends to remain for long periods of time within the stomach unless mechanically removed therefrom, putrefactive changes tend to produce distension, and absorption of the products of putrefaction probably induce a mild toxemia not unlike that found in intestinal obstruction.

In cases of the second type, i.e., those undergoing difficult inhalation anesthesia, salivation, excess mucus secretion, and vomiting tend to be at a maximum, and saliva mixed with mucus and laden with ether vapor is swallowed in relatively large amounts. Such material is highly irritating to the gastric mucous membrane, and because of the interoperative and postoperative intestinal quiescence previously mentioned tends to undergo putrefactive changes.

In cases of the third type, i.e., preoperative obstruction or trauma in and about the stomach at the time of operation, the presence of undigested food in the former case and blood in the latter are of obvious origin. The fact that the stomach has been opened during the course of an operative procedure is no contraindication to immediate postoperative lavage, provided only that the manipulations incident thereto be performed with reasonable gentleness and a soft and flexible stomach tube be used. The modern technique of intestinal suturing should result in the immediate production of a suture line at least one-third as strong as the unbroken surface of

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the organ, and under these circumstances perforation of the viscus with the stomach tube becomes a source of no particular anxiety. It must be remembered in this connection, however, that for a period of about three days postoperatively the suture-line becomes progressively weaker and weaker so that perforation becomes, during this time, a progressively increasing danger. As the result of operations on the stomach there is almost inevitably a considerable extravasation of blood into the lumen of the stomach either as a result of actual hemorrhage at the time the incision itself is being produced or later as cumulative capillary oozing from the wound edges. The accumulation of this bloody exudate combined with the outpouring of gastric juices in response to its presence in the stomach produces a weight and bulk of material which is undesirable and at the same time is very likely to produce peristalsis and frequently active vomiting as well. Plainly in such cases there is an indication for the performance of gastric lavage, an indication which is not present in the average case.

2. *Technique of Gastric Lavage:* The technique of gastric lavage is not difficult and the amount of time consumed by the procedure is not inordinate.

The position of the patient during the performance of lavage is of some moment. Retching and gagging may occur if the patient is not thoroughly anesthetized, and in the horizontal position inspiration of foreign material into the trachea and bronchi becomes a danger. The possibility of this occurrence is minimized by lowering the patient's head. In the performance of lavage a mouth gag is first introduced if the patient is unconscious: a fairly large stomach tube well lubricated with glycerine or one of the special water-soluble jellies prepared for lubricating purposes is introduced well down into the stomach, i.e., a distance, in the average case, somewhat more than 15 in. from the incisor teeth, care being taken that the tube is actually introduced into the esophagus and not into the trachea, and about ½ pt. of warm water is introduced through a funnel attached to the free end of the tube.

FIG. 3. Patient has been lowered to Trendelenburg position to prevent aspiration of any material which may be regurgitated during lavage; patient's head has been turned to side and mouth gag has been inserted to hold jaws apart.
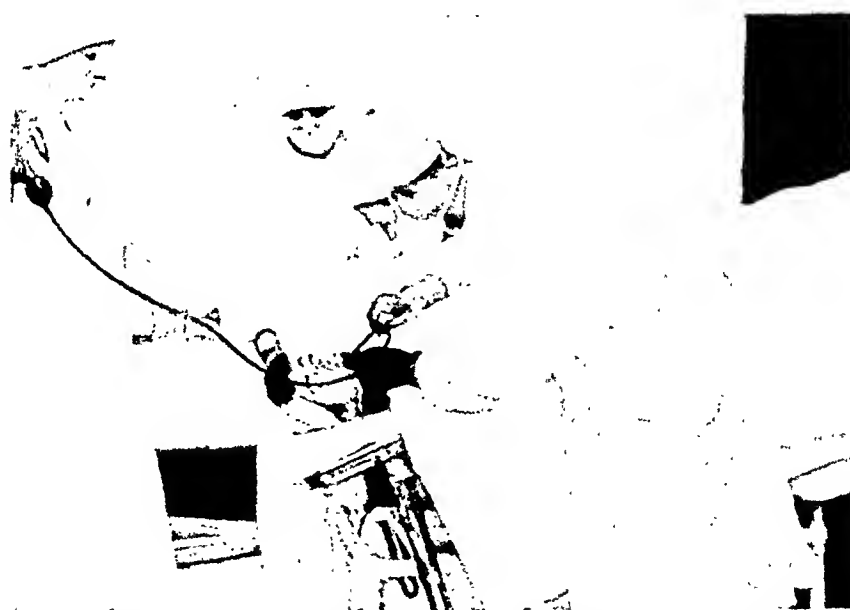

FIG. 4. Stomach tube which is of fairly good size is being introduced through fauces along finger as guide.
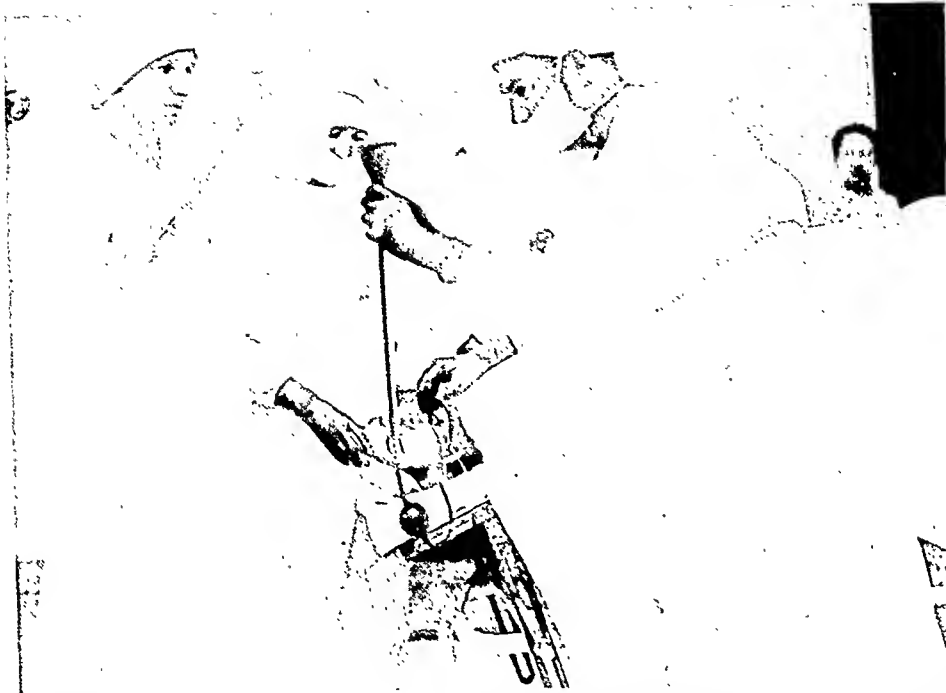
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FIG. 5. Tip of tube has been introduced for distance of about 15 in., and warm sodium bicarbonate solution is being poured into funnel of tube at free end.

FIG. 6. Funnel of tube has been depressed, thus instituting siphonage action; contents of stomach being received in a bucket. Lavage will be repeated until only clear solution is recovered.

FIGS. 3, 4, 5, 6. Performance of postoperative gastric lavage on the unconscious patient before removal from operating table.

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Just previous to the escape of the last of this water from the funnel, the latter is quickly lowered in order to institute a siphonage action, and the contents of the stomach are allowed to escape into a suitable waste receptacle held under the funnel (Figs. 3–6). Only a small amount of water is introduced at the first washing because one has no way of determining accurately the amount of gastric contents already present in the stomach, and one must avoid undue distension of the viscus. As soon as the siphon action from the first washing has stopped additional fluid to the amount of a pint or more is introduced in the same manner as previously, and the process of withdrawal is repeated. This process is repeated again and again until the fluid returns clear. Usually the amount and character of the washings of a stomach as thus obtained is a revelation to one seeing them for the first time, and serve to convince many skeptical observers of the possible value of the procedure as a routine manipulation. The addition of a small amount of sodium bicarbonate to the water used in lavage is of value in partially liquefying and loosening deposits of mucus that may be present, but plain water serves the purpose fairly well, and the possibility of increasing an already present condition of alkalosis should be borne in mind, even though such an occurrence would not require very serious consideration, at least in the average case. The temperature and amount of water or bicarbonate solution introduced are of importance, since the patient is usually unconscious and is in no condition to complain either of excessive degrees of temperature, or of overdistension. A temperature of approximately 110° F. is not excessive, and the addition of heat in this manner serves in a minor way to maintain body temperature, which may be subnormal. The question as to whether some of the solution should be permanently left in the stomach after thorough lavage is one concerning which there may be some difference of opinion; in the majority of cases this is doubtless a matter of relative indifference, though the possible augmentation of an alkalosis should again be considered in

those cases in which sodium bicarbonate has been added to the wash-water.

c. CHANGE OF GARMENTS: The toilet of the mouth, throat, and stomach being complete, attention is turned to the preparations incident to the removal of the patient from the operating table. Many operative procedures unavoidably soil the patient's clothing with hemorrhagic or other fluids; vomitus or occasionally other natural body fluids, and especially sweat, may have so soiled the clothing as to render it unfit for further use, and the legitimate time for making the change from such garments to warm, clean, and dry ones is the earliest possible moment, i.e., while the patient is being transferred to the carriage which is to transport him back to bed or to the recovery room. Washing or sponging of soiled body surfaces should, of course, be performed in conjunction with the change of clothing. Haste in cleansing the soiled surfaces of the body, adjusting the new and clean clothing, bathing of the face, and getting the patient out of the operating room to make room for another case is an admission of inefficiency on the part of the operating room force, the surgeon, or both. Even though the former are willing to tolerate such a situation the surgeon should not be, and if there is a legitimate reason for delay in making room for his continued activity the surgeon should be the first to insist that his own personal convenience be ignored.

II. TRANSPORTATION OF THE PATIENT FROM THE OPERATING ROOM

The conveying to, and the adjustment of, the patient on the movable transporting carriage which is to remove him from the operating room should be a matter of some concern; usually the patient is unconscious, and rough handling may result in actual bodily harm appreciated either immediately or in the form of postoperative complications later. The unconscious patient is unable to release his arms from under his body if they are allowed to become pinned thus, and he cannot

pull up an arm or a leg that has carelessly been allowed to hang over the edge of the carriage; neither is he in a position to defend projecting parts of his body against sharp edges and corners as he is wheeled out of the operating room and perhaps a considerable distance farther through the corridors. To the end that pressure paralysis, bruises, and other harm may be avoided the utmost care should be exercised in arranging the body of the unconscious patient and protecting his limbs.

Probably the ideal situation with respect to the patient's recovery is one in which transportation is first to a "recovery room" immediately adjoining the operating theater, wherein the patient is allowed to remain until consciousness is fully established. A certain number of patients will require especial care in the period immediately following operation, such as infusions and transfusions, and these can usually best be managed in physical surroundings especially adapted to the purpose and in close physical proximity to sterilizing rooms and instrument cases.

Unfortunately the "recovery room" is a luxury not always available, and frequently it becomes necessary to transport the patient immediately to his own bed. This may represent a rather considerable distance, particularly in the larger institutions.

Modern hospital construction has done much to minimize untoward accidents on the way from operating room to bed, such as chilling of the patient, asphyxia from inspired vomitus, and accidents incident to unnecessary lifting and shifting of patients; the distance from the operating room to the surgical wards and rooms has been shortened, transportation from one floor to another has been facilitated by the installation of elevators, and area-ways and passageways have been arranged so that they can be well heated and protected from draughts. However, there are still many active operating hospitals in which such ideal conditions do not obtain, and it sometimes becomes necessary to wheel the patient out of a superheated operating room into a cold passageway or even out of doors and

across a yard or enclosure, and in any case elevator wells are notoriously draughty places at best, so that the matter of carefully covering and wrapping the patient to avoid the possibility of undue chilling is invariably a matter of great importance. Even in those cases in which the passage from operating room to bed is normally short and quickly traversed the patient should be carefully protected from chilling since there are many accidental occurrences which may unexpectedly lengthen the normal time interval, such as elevators temporarily out of commission or mistakes in directions as to destination.

If unconscious or helpless patients are to be transported any considerable distance from the operating room, it is not only desirable but absolutely essential that some capable attendant be delegated to walk beside them and watch carefully for the development of any complications that may arise. Ideally this is the duty of the anesthetist because care of the anesthetized patient is his special province and, if competent, he is best able to deal with any emergencies that may supervene.

If possible the anesthetist should never leave a patient until that patient has regained consciousness; the practice of releasing an unconscious patient into the hands of an untrained, possibly mentally retarded, and often careless orderly or hospital attendant to be conducted sometimes considerable distances back to bed and then to be committed indifferently to the care of a student nurse, practical nurse, or graduate nurse, the attention of any one of whom is perforce likely to be occupied with other matters is, to say the least, undesirable. During the period of transportation the patient may develop certain rapidly fatal complications, such as asphyxia from "swallowing the tongue," "drowning," as the result of the inspiration of material regurgitated from the stomach, or may become quickly exsanguinated from an unexpected reactionary hemorrhage, in addition to suffering from a host of minor traumata which make for morbidity

rather than actual mortality. Orderlies, ward attendants, and other relatively untrained persons are in no position to recognize the development of such conditions, or to treat such emergencies intelligently when they arise. It has been the unhappy experience of too many surgeons to learn that a patient who had left the operating room in good condition a few minutes previously had died before he could reach his bed and that the attendant in charge of the patient had been quite unaware that anything untoward had occurred.

If the anesthetist cannot be spared to perform this most important function an especially trained nurse should be delegated to the duty, and it is highly desirable that such a person should be informed not only as to the anesthetic employed in any given case but also as to the operative procedure performed, in order that she may be alert to recognize any particular complications to which the individual patient may have been predisposed.

III. Reception of the Patient in His Bed

The preparation of "ether" beds and the reception of patients in their beds need not be detailed in this connection, because such matters are thoroughly discussed in treatises on practical nursing and are commonly well handled by the nursing staff. The patient's bed should, of course, be warm and unless special indications are present should be in a horizontal position or still better moderately inclined to the head; no pillow should be allowed until reaction from anesthesia has become completely established. During this period the constant attendance of the anesthetist or at least a competent nurse should be considered obligatory, since many of the complications previously noted as likely to occur on a transporting carriage are also likely to occur in bed during the period of unconsciousness. Unless definite contraindications exist the patient should be turned on the side, and in any case the head should be kept turned to the side.

IV. CARE OF THE PATIENT IN BED

The early care of the patient in bed involves a discussion of the question of "postoperative orders," because it is customary for the surgeon to outline, in connection with the operative procedure, the treatment which he wishes the patient to receive during the initial twelve to twenty-four hours of convalescence. The postoperative orders are usually written on the patient's "operative sheet" at the operating table, and are transported with him to his bed.

A. THE ADMINISTRATION OF MORPHINE: Of all the indications during the earliest hours of convalescence the most important, from the point of view of both the patient and the medical attendant, is the relief of pain. Surgical procedures are invariably followed by a certain amount of pain, the degree of which varies not only with the nature and extent of the operative manipulation, but also probably with the sensitiveness of the individual patient to pain stimuli. The surgeon is ordinarily the least competent person to appreciate the nature and severity of his patient's sufferings, because familiarity, particularly the remote variety, breeds contempt in surgery as elsewhere, and the surgeon rarely or never has the experience of actually feeling the sensations which he provides for others as a part of his daily routine of life. However, the picture of the unfortunate surgeon who himself has to undergo an operative ordeal is sufficiently familiar to his professional brethren, and the usual insistent demands of such a one for speedy relief from his pain are frequently somewhat amusing in view of his own equanimity when others are suffering. At all events most surgeons who have recently had first-hand experience with surgery from the patient's point of view are willing to admit that the pain of operative manipulations is frequently gravely underestimated.

The only sure relief for ordinary pain is to be found in the administration of sufficient doses of opium, usually in the form of morphine, administered hypodermically. This opinion is

not universally shared by surgeons, however, and in fairness to those who hold a different view some space should be allotted to the reverse opinion. A few representative opinions as gleaned by Collins from recent literature are mentioned.

Clinton Cushing[1] holds that the less opium a patient receives after an abdominal operation the better, and the larger proportion of his patients receive no anodyne whatever. Deaver and Muller[2] believe that the giving of morphine after abdominal operations is occasionally responsible for a mortality and imply that the use of morphine is frequently undesirable. Skene Keith[3] says that no drug is capable of doing greater harm than morphine when used in a haphazard way. Haubold[4] believes that the administration of opiates is objectionable in principle but necessary in a certain number of cases, though he leaves us to infer that by far the greater number of cases do not need it. Moynihan[5] says, "The administration of morphine after an operation is rarely necessary nowadays, especially since the introduction of Crile's method (anoci association)," but he continues with the statement that he never withholds morphine if the patient is suffering, and also states that he uses both morphine and opium sparingly to the great advantage of his patients. Howard A. Kelly[6] advocates the use of morphine by hypodermic injection in doses of ⅛ or ¼ of a grain, for not longer than thirty-six to forty-eight hours, but he cautions against the use of the drug in hysterical women, and says that frequently when the patient is tired and restless, rather than in actual pain, a sponge bath with tepid water and a cup of hot water or tea will often take the place of a narcotic. He does, however, declare himself emphatically in favor of morphine by hypodermic injection during the first twenty-four hours in all cases of severe suffering. Possibly authorities are about equally divided on the subject of the routine use or non-use of morphine postoperatively, half of them believing that in the usual case it is contraindicated, whereas the other half think that it is indicated.

It will be noted from what has been said, however, that even those who disparage the postoperative use of morphine as a routine procedure recognize its value in certain cases, and therefore, in the absence of any definite proof that morphine as ordinarily used is particularly harmful, it is believed that it should not be withheld.

In accordance with the principles previously enunciated in connection with the preoperative use of morphine, doses of less than ¼ grain for adults weighing 125 lb. or more are probably not indicated. If morphine is to be used at all it should be used in doses sufficient to relieve the patient completely, and it should be given sufficiently early so that no interval of pain supervenes between the anesthesia of the anesthetic agent and the narcosis of the narcotizing drug.

Patients who regain consciousness and are subjected to suffering early in the postoperative period may lose their morale to such an extent that it becomes impossible to decide subsequently whether morphine is ineffective, and suffering has not been relieved, or whether complaints are fanciful and expressions of fear of anticipated pain. It is, therefore, usually desirable to order the first dose of morphine as soon as the patient is settled in bed, so that the actions of the anesthetic and of the opiate may overlap. On the other hand, patients who have been adequately relieved of the earliest and severest pain are much more apt to bear stoically such pain as remains when it becomes necessary or desirable to discontinue the use of opiates.

Although the postoperative requirements of patients with respect to opiates varies widely, a dose of ¼ grain of morphine administered every three hours for from 4 to 6 doses may perhaps be taken as a mean value. Some patients can dispense with the last few doses; many will require repetition of the standard dose somewhat less frequently; but it should be remembered that complete freedom from pain is the desideratum, and no hesitancy should ordinarily be felt in more frequent administrations if such seem to be required.

That the prolonged administration of opiates is highly undesirable no one will question. It is rarely advisable to keep patients under the influence of morphine for longer than forty-eight hours postoperatively, because of the danger of the development of the morphine habit or a toxic psychosis. At the end of forty-eight hours, if further continuance of the use of narcotics seems desirable, it is better to begin the gradual substitution of codeine for morphine.

Codeine, when used as a substitute for morphine, must be administered in comparatively large doses; doses of 1 grain are as small as can be used with any expectation of success.

b. Postoperative Administration of Fluids: The administration of fluids in adequate amounts postoperatively is perhaps the most important single therapeutic or supportive procedure at the command of the surgeon. The patient comes from the operating room (1) having lost relatively large quantities of water by diaphoresis, (2) having possibly vomited considerably and being almost inevitably bound to vomit some more, (3) in danger of developing a starvation acidosis from the withdrawal of food, (4) almost inevitably bound to develop within a few hours a rise of temperature accompanied by abnormally increased water metabolism, (5) usually under the necessity of eliminating quantities of toxins and other waste products by way of the urinary tract, and (6) inevitably bound to be intensely thirsty as soon as consciousness returns in case the operation has been performed under general ether anesthesia. Under these conditions the intake of a normal allowance of fluid, e.g., roughly 2 l. in the twenty-four hours, must be hopelessly inadequate.

Two general plans for supplying fluid postoperatively are recognized. In the first, the patient is allowed water by mouth just as soon as the period of immediate postoperative nausea and vomiting is over, and the amount of water given is dependent solely upon the patient's ability to retain and absorb it. Some surgeons prefer to give sips of warm water, others sips

of cold water, and still others small pieces of cracked ice. The temperature of the fluid is of relatively slight importance as compared with the main desideratum, which is quantity.

Undoubtedly there are many patients and many varieties of operative procedures in which such a method works very well. Especially would this be the case in operative procedures other than laparotomies and in those instances in which some other method of anesthesia besides general inhalation anesthesia had been employed. Unfortunately, however, as far as the postoperative administration of fluids is concerned, many operations are laparotomies, and generally inhalation anesthesia still holds the center of the stage as being, by and large, the method of anesthesia of widest application.

Though it is undoubtedly true that many patients are capable, notwithstanding this, of retaining and absorbing sufficient amounts of fluids by mouth, there are certainly some who react by developing a more or less persistent form of vomiting, and who, many hours subsequently, are still unable to tolerate anything by mouth, and this at a time when the need for fluids has become acute.

Postoperative vomiting works a very real hardship on patients, especially upon those subjected to the more serious laparotomies; the act of emesis not only exerts traction on wound edges and thereby causes pain, but the violent muscular contractions involved in the act itself rapidly exhaust the reserve strength of the patient, a reserve strength which is, after all, too little at best.

Of course, if patients become nauseated under any plan of treatment and persist in going through the straining movements incident to vomiting, it is far better that they should have something to expel than that a mere series of unsatisfying spasmodic muscular contractions should result; accordingly, a good plan is to give such patients copious amounts of fluid, thus assuring a thorough lavage of the stomach and this even though none of the fluid actually remains in the stomach to be subsequently absorbed. In all cases in which patients

vomit to any considerable extent, however, even though fluid is given in quantity it must be remembered that actually more fluid may be expelled than is swallowed because reverse peristalsis tends to become established, and secretions, not only from the gastric mucosa but also from the duodenum and its associated glands, tend to be evacuated. In the end, therefore, instead of supplying fluids by mouth one may actually abstract such fluids as are already present in the body, if the early administration of fluids by mouth provokes much nausea and vomiting.

The rectal or even parenteral administration of fluids constitutes the second plan, and though it is also open to certain objections, it nevertheless seems to offer advantages, especially in connection with patients who have been subjected to general anesthesia, and those who have undergone some rather serious operative ordeal. Rectal administration is specified rather than hypodermoclysis or intravenous infusion, not because the latter methods are less valuable but because rectal administration is considered less drastic and consequently more generally applicable and desirable. The entire subject of water balance and dehydration will be considered in some detail later in a separate chapter, and an attempt will then be made to evaluate more adequately all the methods of combating dehydration. Objections have been raised against the rectal administration of fluids both from the point of view of efficiency and also from the point of view of expediency.

The contention has been made that fluids are not absorbed readily from the rectum. This is probably true in case the administration is improperly made. Improper temperature of the fluid given, uncleanliness of the bowel wall, improper pressure relationships, and other factors will frequently lead to expulsion of fluid and failure of the method. On the other hand, many thousands of patients have tolerated it well when properly given, and there are very few surgeons who question its value in all cases.

About 1000 c.c. of fluid are ordinarily ample in cases of simple laparotomy to tide the patient over the initial period of nausea, which, under the plan of liberal narcotization with morphine, should not last more than from six to eight hours. At the end of this period patients characteristically tolerate fluids by mouth without much difficulty. Suffering from thirst has, in the meantime, been mitigated by the action of the narcotic and has also been actually combated by the rectal administration of fluids, so that the patient's morale is unbroken, and the temptation to overload the stomach with fluids is not great. Fluids are consequently more likely to be taken slowly and with moderation.

Plans involving a combination of rectal and "per os" administration of fluids in the early hours of convalescence are to be discouraged, because they invite carelessness on the part of medical attendants and nurses, and are apt to eventuate in a slipshod "trial and error" regime in which the way of least resistance dominates.

If the plan of rectal administration be followed, a rigid regime of "nothing by mouth" should be enforced. If the plan of "per os" administration be favored, water only should be allowed for at least from six to twelve hours.

c. The Postoperative Position of the Patient in Bed: In spite of the fact that much has been written on most of the other features connected with the postoperative care of patients, very little attention has apparently been paid to the matter of the desirable postoperative position of the patient in bed. Considering the number of patients who are either allowed or admonished in most hospitals to assume the dorsal recumbent position, it would seem that this position is the one of choice for a great variety of cases.

Actually, however, this is from both theoretical and practical standpoints probably not in accordance with the facts. The placing of patients in a stereotyped position, regardless of the operative procedure performed or the condition of the patient, is probably an evidence partly of timidity and partly of sheer thoughtlessness.

There was doubtless a period in the not too distant past when the art of abdominal closure was still relatively undeveloped during which patients who had undergone the ordeals of

FIG. 7. Patient sitting virtually upright in bed almost immediately following operation of thyroidectomy.

laparotomy had to be treated with the utmost gentleness lest complete rupture of the suture-line should occur, or at least sufficient stress should be brought to bear upon the suture-line as to render likely the development of a postoperative herniation. With modern technique in abdominal closure, however, such a complication is not particularly to be feared, provided that changes of position be executed with proper support to the body and with gentleness. The medical attendant need fear no harmful consequences in the average case from turning the patient from one side to the other, and certainly, except in rare instances, there is no excuse for enforcing the assumption for long periods of time of any position which is uncomfortable.

The position in which a patient ought to be placed in bed following operation varies with a considerable number of factors, some of which will be mentioned in connection with the

speeifie after-treatment of various operative procedures. For the present, however, a eonsideration of some of the general prineiples underlying postoperative posture only will be at-

FIG. 8. Patient in Fowler's position under treatment for diffuse peritonitis. Note 8 in. blocks under headposts of bed.

tempted. It is not infrequently desirable and perfectly feasible to allow the patient to sit virtually bolt upright immediately following transfer from the operating room to his bed; this applies partieularly to eases of eranial operations and operations on the neck, such as thyroidectomies, and espeeially in cases in whieh local anesthesia has been used (Fig. 7). Such a position favors drainage of blood from the head and thereby tends to discourage the development of loeal edema. In operations on the neck sueh a position aids the patient in getting his breath through a traehea often partly eollapsed either by aecumulations of plasma or blood elot in the surrounding tissues. In the aged and in other patients in whom pulmonary lesions are already present or anticipated the upright position may be

most desirable in facilitating respiratory movements and ensuring adequate pulmonary ventilation. Patients with idiopathic asthma and those with cardiorenal disease can frequently tolerate no other position.

In arranging a patient in the upright position care should be taken to ensure muscular relaxation. Pillows and possibly other improvised supports should be used freely both at the back and sides, and especial care should be taken to secure and maintain a comfortable and natural bend at the knees, for few positions are more trying than one in which the thighs are flexed on the abdomen while the legs are maintained in complete extension.

The "Fowler" position, in which the trunk, limbs, and head are all in a relatively straight line, but in which the head and trunk are higher than the lower extremities is often a very useful position. It is most conveniently brought about by elevating the head of the patient's bed on blocks without otherwise disturbing the disposition of his body (Fig. 8). Blocks of various heights are useful, especially 6, 8, 10, and 12 in., one block being placed under one leg of the head of the bed and a block of the same height being placed under the other leg. Special beds, in which are incorporated mechanisms for raising and lowering the head and feet by means of cranks and levers, are unnecessary luxuries which do, however, possess the obvious advantage that they can usually be manipulated by a single pair of hands and do not require the outlay of an amount of strength beyond that usually possessed by female nurses and attendants.

The "Fowler" position is useful in combating respiratory embarrassment in patients too sick to tolerate a frank sitting or semi-sitting position. The respiratory relief is achieved chiefly through gravitation of the abdominal viscera away from the under surface of the diaphragm, thus facilitating unhampered diaphragmatic movements.

The "Fowler" position is also of the utmost value in the treatment of actual or anticipated peritonitis. To the late

John B. Murphy belongs much of the credit for the rationaliz-
ing of the treatment of general septic peritonitis following
intestinal perforations of various kinds. He advocated the
assumption of the exaggerated "Fowler's" position and the
administration of the rectal drip.

Formerly, it was taught that the diaphragmatic peritoneum
was absorptive to a greater degree than that of the rest of the
abdominal cavity, and the reason assigned for the assumption
of a postoperative head-high position was the avoidance of
unnecessary peritoneal absorption. That absorption does take
place more rapidly from the upper abdomen is not at all
unlikely, although the reason for this is probably not to be
sought in any peculiarity of the peritoneum of the upper
abdomen itself but rather in the increased movement resulting
from respiratory excursions in this part of the abdomen, a
sort of peritoneal massage. A more important reason for main-
taining a moderate head-high position in the average case
of peritonitis is, however, the desirability of preventing
residual abscess formation in the upper abdomen, where it
might be relatively inaccessible surgically, and at all events
difficult of diagnosis, and conversely to favor the development
of such a complication, if such be unavoidable, in the pelvis,
where diagnosis is easier because examination is easier and
where evacuation without formal laparotomy is usually not
very difficult.

The "broken" position is one intermediate between the
sitting and the "Fowler" position. In this position, the head
and trunk are elevated to make, with the lower extremities,
an obtuse angle, while the thighs are somewhat bent upon
the abdomen and the legs upon the thighs. In order to main-
tain the position with comfort the body must receive adequate
support. A back rest either separate from, or incorporated
into, the construction of the bed, serves to raise the torso,
and a sling arranged under the thighs and attached to the
head of the bed prevents the patient from sliding downward.
Pillows are arranged to give lateral support to the body, and

ample support under the knees is provided also by means of pillows.

The "broken" position, being a modified "Fowler" position, shares with the latter its general advantages. However, the broken position is of especial value in connection with the postoperative care of patients in whom incisions have been made in the inguinal region, as it favors relaxation of the tissues in the groin. Such relaxation is especially desirable in inguinal hernipolasties in which traction on wound edges is particularly undesirable because of the danger of rupture of the suture-line and recurrence of the hernia.

The "dorsal recumbent" position in which the patient lies flat upon the back and the bed is horizontal is, as previously mentioned, perhaps most frequently used. When unduly prolonged, however, it tends to facilitate the formation of decubitus ulcers, as, of course, does also the prolonged assumption of any other position. Unless the normal dorsolumbar curvature is maintained by a suitable support, pains in the back and limbs frequently develop, due to prolonged strain upon the erector spinae muscles and tendons. The strict maintenance of such a position for prolonged periods of time favors also the development of hypostatic pneumonia especially in the aged, and is rarely or never necessary.

The "Trendelenburg" position, in which the head, torso, and extremities are supported in the same straight line, but the feet are higher than the head, is occasionally of value. Such a position tends mechanically to prevent the gravitation of secretions from the mouth and throat into the lower respiratory tract in the unconscious patient. It is, therefore, sometimes indicated in patients who are unduly nauseated postoperatively and who are either unconscious or semiconscious from the effects of anesthetics or narcotics, as well as in patients unconscious from other causes. In patients with visceroptosis such a position is most comfortable, probably mainly because it relieves traction on the mesenteric vessels and thereby relieves a condition of partial obstruction of

the duodenum at the point where the mesenteric vessels cross the duodenojejunal junction. The possibility of relieving certain cases of gastric dilatation by this position is mentioned elsewhere. In conditions of actual or threatened cerebral anemia such a position favors gravitation of blood to the head.

Meyer[7] and others have suggested the possibility of using such a position in the prophylaxis of thrombophlebitis, since the inclination of the body toward the head tends to prevent stasis of blood in the large veins of the lower extremity. So important does Meyer consider this use of the position that he has recommended its routine employment after the first forty-eight hours in all cases in which such a posture is not contraindicated by other considerations.

The "Sims" position either in its classical form or combined with either the "Trendelenburg" or "Fowler" position can often be used to advantage. The classical Sims position is attained on a horizontal surface by (1) turning the patient on the side (characteristically the right side), (2) pulling the dependent arm and shoulder backward so that the patient lies partly on the anterior aspect of the shoulder and partly on the chest, (3) partly flexing the dependent leg on the thigh and the thigh on the leg, and (4) fully flexing the upper leg on the thigh and adjusting the corresponding leg so that it rests on the supporting surface of the bed anterior to the dependent leg.

Raising the head of the bed on which a patient lies thus produces a combined "Sims" and "Fowler" position, and raising the foot of the bed produces a combined "Sims" and "Trendelenburg" position. Suitable arrangements of supporting pillows are necessary in order to make such positions comfortable for prolonged periods of time.

In those cases in which the gall-bladder bed has been drained or drainage of the common duct has been instituted after cholecystectomy, or in which simple gall-bladder drainage has been performed, the assumption of "Sims" position places the gall-bladder bed, or the gall bladder (if not removed)

in a relatively elevated position with respect to the skin incision, so that gravity drainage is thus facilitated.

The same applies to operative procedures in which the cul-de-sac of Douglas or the rectovesical pouch requires to be drained through an abdominal incision; the lowest part of the true pelvis, in the "Sims" position, is made to assume a position superior to that of the skin incision, and drainage is accordingly assisted by gravity.

The "Sims" position is of especial value in such cases in the early hours of convalescence, i.e., at the time when the need for adequate drainage is at its height. In such cases the "Sims" position should be arranged when the patient is placed on the carriage which conveys him from the operating table to bed and should be continued for from eighteen to twenty-four hours. At the end of this time the maximum amount of drainage will have occurred, and thereafter the patient may gradually be turned upon his back. Peritoneal exudation and vascular oozing will cease certainly by the end of the fourth day.

In the operation of gastroenterostomy the gravitation of gastric contents through the stoma between the stomach and the jejunum is much facilitated by causing the patient to assume a moderate "Sims" position and raising the head of the bed on blocks. Such a position is both grateful to the patient and tends to prevent vomiting, which may be a source of aggravation to both patient and surgeon.

v. Postoperative Backache

A large number of patients soon after operation complain of severe pain in the muscles of the back which does not usually subside for a number of days. Probably a frequent cause of this pain is the use of a flat, hard, operating table which does not take into account the normal lumbar curve of the back and the consequent production of back strain during operation. Back strain of this kind is frequently exaggerated by the leaning of operators and assistants upon the patient for support

or the placing of objects more or less heavy upon the patient's chest or abdomen. The treatment for such a complication is very obviously mainly a prophylactic one. A small pillow placed under the head, under the normal lumbar curve, and under the knees of a patient at the time of operation will do much to prevent the development of the condition. Nurses and assistants should also be impressed with the necessity of respecting the body of the unconscious patient to the extent of refraining from using it as a means of support either for themselves or for other objects, such as basins, pans, and trays.

vi. Postoperative Distention

The occurrence of a certain amount of distention or meteorism following abdominal operations is to be expected, though to nothing like the degree previously seen in the days when drastic preoperative purgation and unwise manipulation of the abdominal viscera during operations were more widely practiced and patients were taught to fear gas pains more than the operative procedure itself. Too tight or improper application of dressings may exaggerate an otherwise inconsiderable degree of distention, and much relief may be gained in these cases by judicious loosening or slitting of the restraining dressings.

In cases of moderate severity two simple expedients will usually suffice to give the patient very rapid relief: (1) If proctoclysis is being given it should be stopped and in place of the tube for the rectal drip should be inserted a fairly large rubber rectal catheter; this should be pushed well up above the internal sphincter and left in position; it allows the escape of gas which may be in, or find its way into, the lower bowel. (2) An electric light cradle should be placed over the patient's abdomen, the latter being thoroughly exposed by pulling the night gown well up, the bed clothing being replaced over the top of the cradle and the temperature within being kept at an even temperature of 100° F. by adjusting the number of light

bulbs in the circuit. The cradle takes the weight of the bed cloth-
ing off the patient's abdomen, the heat tends to produce mus-
cular relaxation, and the combination of light and heat produces
a mild local hyperemia. The relief experienced by patients
receiving this simple treatment is often almost miraculous.
A much more extended discussion of this subject will be given
in a succeeding chapter.

VII. POSTOPERATIVE ADMINISTRATION OF FOOD

Patients who have been in comparatively good health
prior to operation suffer no real hardship as a result of the
inevitable short period of starvation which ensues upon
major surgical procedures. For a period of twenty-four hours
or more following laparotomy operations and general anes-
thesia a patient's gastrointestinal tract is in a state of paresis
and depressed secretory activity and accordingly is unable
to digest and assimilate food. This state of affairs is attested
clinically by anorexia, and in case any irritation of the gastro-
intestinal tract coexists, by nausea and vomiting. Failure to
respect this condition of affairs results either in expulsion of
any food material which may be administered or in stasis of
such material until digestion is actively resumed. Nothing but
harm can result from too early attempts to feed the postopera-
tive patient, and the overzealous medical attendant who
attempts to force food by mouth at a time when the patient is
in no condition to assimilate it courts the development of
unnecessary nausea and vomiting, gastric dilatation, intestinal
putrefaction and distension. Furthermore, in those patients in
whom peritonitis is suspected or anticipated, administration of
food by mouth is especially contraindicated because the pres-
ence of food material in the upper alimentary tract serves as an
excellent stimulant to peristalsis, and inasmuch as motor activ-
ity always tends to diffuse a peritonitic process, a localizing
peritonitis may thus become generalized. During the period of
postoperative functional inactivity of the alimentary tract,
therefore, a very definite indication is present for withholding

food, and during this interval nourishment, if urgently demanded, is supplied parenterally.

Return of function to the digestive tract is almost invariably manifested by a return of appetite, and for this reason a fairly safe rule to follow in average cases is to allow food as soon as the patient begins to feel hungry.

The first items in the dietary of the postoperative patient should contain a minimum of food value and should be in liquid form; the substances usually given first are weak tea, in which is dissolved a small amount of sugar but without lemon, bouillon or broth from which the fat has been carefully skimmed, albumin water or very thin gruel, and weak malted milk. These substances contain little real nourishment, require a minimum of digestion, and leave no residue. Milk itself is not a suitable article for early postoperative feeding because, although liquid when swallowed, it coagulates almost immediately on entering the stomach and thereafter must be treated as a solid food.

The first attempts at feeding constitute a sort of experiment which if successful may be cautiously continued, but which if unsuccessful must be interrupted until a further lapse of time has occurred. The amount of material given is small at first, merely an ounce or two, but the bulk usually can be rather rapidly increased if digestion is found to be active. Patients can frequently tolerate the aforementioned items of food at the end of about twenty-four hours. At the end of thirty-six hours in very favorable cases junket or oatmeal jelly may be added. On the third postoperative day in addition to the junket and oatmeal jelly, cocoa, ice cream, lemon or wine jelly, and strained gruel may be given. If the patient's condition is unusually good there may also be added thick soup, milk toast, cereals, custard, rice, chopped beef, baked potato, baked apple, and poached or boiled egg. Feedings should be allowed every three hours, and should be somewhat restricted in quantity. On the fourth postoperative day patients will frequently tolerate the ordinary full hospital diet.

VIII. The Use of Cathartics Following Abdominal Operations

Formerly it was the custom to give patients a cathartic on the third postoperative day in cases of simple, clean abdominal operations. Experience has taught, however, that not only is this procedure usually unnecessary but it is frequently quite harmful and leaves the patient in a restless and miserable condition. In the average case the bowel will have been fairly well emptied prior to the performance of the operative procedure, and during the two or three days following any operation the patient commonly eats but a small amount of food and usually food of a variety which leaves little or no residue. Accordingly the bowel, being relatively empty for a period of days after operation, no harm can result from allowing the patient to go for some time postoperatively without a bowel movement, and in any case, if it seems necessary on the third or fourth day to move the bowels, an enema meets the indication much more perfectly than a cathartic. Probably it is better to reserve the use of the enema until the fifth or even sixth postoperative day in those cases in which the bowel does not move spontaneously rather than to make use of this measure too early in the convalescent period. In cases of peritoneal inflammation carthartics may prove positively harmful and even exceedingly dangerous. Intestinal quiescence in postoperative cases complicated by peritonitis is a salutory provision of nature, and the flailing of the intestine to action by cathartics simply predisposes to the spreading of infection.

IX. Getting Up from Bed

The duration of the postoperative stay of a patient in bed is properly determined by a number of factors amongst which are the nature of the operative procedure, the extent and location of the operative incision, the manner of wound healing, whether by primary or secondary intention, and the age and general physical condition of the patient.

Recumbency in bed for a period of days postoperatively accomplishes two fundamental functions: (1) it tends to conserve the patient's reserve vitality and thus fortifies him against the effects of shock and hemorrhage, infection, toxemia, dehydration, acidosis, and the various other systemic complications of the operative procedure; and (2) it tends to put the site of operation at rest and thus, on the one hand, to favor repair and, on the other, to prevent separation of the wound edges during the period of incomplete union.

Accordingly, it follows that patients should not ordinarily be allowed out of bed until (1) systemic equilibrium has undergone complete readjustment and (2) wound repair has progressed to such a point that union of wound edges is secure, and no further danger of wound separation is to be feared.

Elevation of a patient's temperature and pulse rate is generally the most obvious evidence of unstable metabolic equilibrium, and ordinarily therefore constitutes a contraindication to any unnecessary exertion such as would be involved in getting up and about. Furthermore, care should be taken to recognize any less evident systemic derangements not necessarily associated with pulse and temperature changes, such as cardiac decompensation and nephritis. Other things being equal, however, the natural inclinations of the patient are about as reliable a guide as can be conveniently found; usually patients can be allowed out of bed as soon as they themselves feel capable of the exertion incident thereto.

The subject of wound healing has been considered at some length elsewhere. In connection with that discussion it has been stated that for the first three or four postoperative days tissue changes occur in non-infected wounds which are principally of a destructive or autolytic nature, and that not until the end of this period does the reparative process really begin with the multiplication and maturation of fibroblastic cells. Several very interesting experimental studies have been made tending to show that the tensile strength of a healing

wound is mainly a function of the growth of such tissue, and that a rather definite and constant curve of wound healing can be constructed for all types of wounds the characteristics
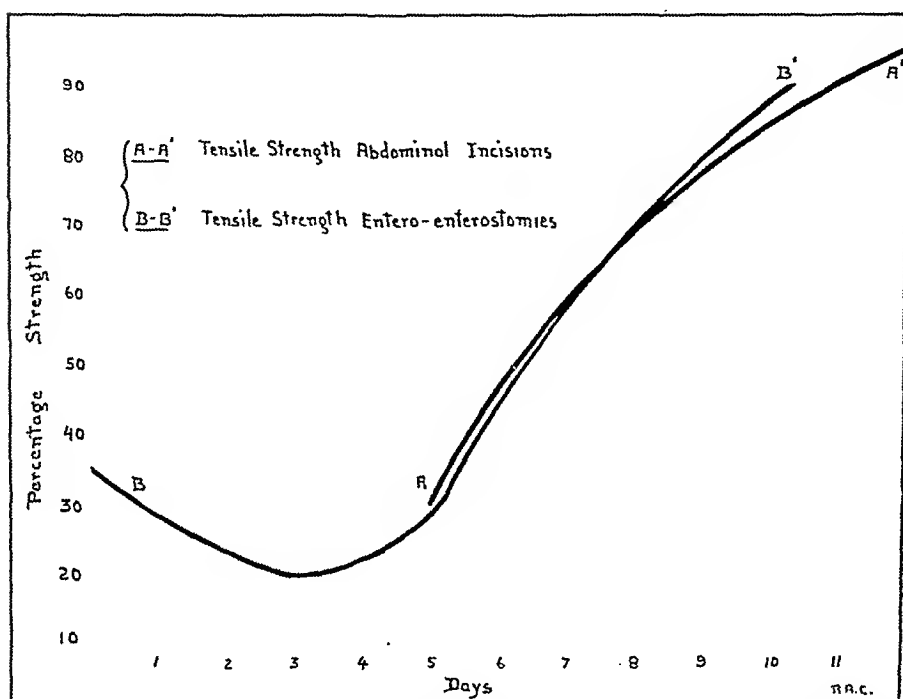

FIG. 9. Tensile strength of two different kinds of wounds on successive postoperative days. Curve A-A' is taken from the experimental work of Harvey.* The curve B-B' is reproduced from the experimental work of Cutting† and represents healing in intestinal wounds. Dogs were used in both sets of experiments. Curves represent mean values computed from a number of separate observations.

of which are a latent period of four days in which no appreciable healing occurs, an abrupt and maximal growth of tissue and increase in tensile strength of the wound beginning at the end of this period, which however progressively diminishes in rate during subsequent days and reaches an asymptote in from ten to fourteen days, at which time the tensile strength of the wound characteristically equals or even exceeds the

* Harvey, S. C. The velocity of the growth of fibroblasts in the healing wound. *Arch. Surg.*, 18: 1227, 1929.

† Cutting, R. A. The relative mechanical strength of enterostomies performed with and without clamps. *Arch. Surg.*, 17: 658, 1928.

preoperative tensile strength of the preoperative area and the postoperative tensile strength of surrounding tissue (Fig. 9).

In view of these findings certain rather obvious conclusions can be drawn with respect to the placing of stress and strain upon postoperative incisions. During the first three or four postoperative days such tensile strength as operative wounds possess they derive almost entirely from the mechanical trussing or splinting of the sutures or other mechanical devices introduced at the time of the operative seance or placed about the lesion then or subsequently. Because the tissues through which sutures are placed at the time of the original operation are usually firm and non-yielding the incision immediately after operation characteristically presents a degree of tensile strength somewhat greater than that presented by the same lesion after the lapse of a day or two at which time autolytic and inflammatory changes have produced more or less edema and tissue friability, and the suture material has become softened and partially liquefied.

For this reason, other things being equal, operative wounds are less likely to rupture immediately after operation than at the end of the first three or four days. The third, fourth, and fifth postoperative days, being the period of minimum tensile strength, represent the time interval during which particular care should be taken to guard the patient's operative incision against rupture. From the fifth day on, however, less and less danger may be anticipated from this source, and the patient may be up and about as soon as an amount of tensile strength has been developed sufficient in the operator's estimation and experience to present the necessary margin of safety required by the particular incision.

There are some surgeons who feel that such conditions are fulfilled in the case of simple small appendectomy incisions at the end of the fifth or sixth day, but a glance at the graphs of wound healing herewith reproduced shows that at this time only about 40 to 50 per cent of the normal tensile strength of the tissues has been developed. Consequently it seems

rather hazardous even under the most favorable circumstances to attempt so early mobilization of the patient. At the end of seven days nearly 70 per cent of the normal tissue strength has been developed in the wound, and usually this is considered sufficient in the case of lower abdominal incisions of moderate extent. Patients in whom extensive operative procedures have been undertaken and especially those with moderate or extensive upper abdominal incisions should be given the benefit of the added margin of safety of twelve or fourteen days' rest in the recumbent position.

These observations apply, however, only to wounds in which suppuration does not occur and to patients who are not debilitated by advancing age or systemic disease. In such cases and in wounds in which drainage tubes have been inserted or in which drainage is occurring without encouragement from mechanical devices the postoperative period of recumbency should be proportionately lengthened; in such cases no very definite rules can be formulated. Every case falling within such a classification presents its own individual problems; when one is confronted with such problems surgical experience and judgment alone can be trusted. Even at the hands of the most experienced surgeon cases occasionally undergo nonunion and subsequently rupture, and the surgeon is sometimes no less surprised than the patient when such a result is encountered.

As soon as the patient is allowed out of bed the medical attendant should consider the advisability of the application of some artificial support to the traumatized area. Undoubtedly there are many cases in which an abdominal support or binder is necessary in the early ambulatory period after laparotomies, but in cases in which no local complications have arisen the value of such devices is exceedingly doubtful. Patients usually wear such supports in case they are recommended or provided and believe they derive real benefit from them; but largely because of the influence of obstetricians who have found serious retardation in resumption of abdominal

tone and function following parturition in case abdominal supports are worn, surgeons have rather generally come to question the value of such methods. Probably in most cases a better plan of postoperative care is the early discarding of all mechanical devices and the gradual institution of a system of exercises designed to stimulate normal physiological function of the abdominal musculature or even a "work hypertrophy."

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CHAPTER IV

SHOCK AND COLLAPSE

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SHOCK AND COLLAPSE

1. DEFINITION OF SHOCK AND COLLAPSE

The term "shock" is a clinical name for an abnormal condition or state, more or less well defined, which is characterized by a progressive fall in blood pressure, a decrease in pulse pressure, a subnormal temperature, and rapid, shallow respiration; in short, a state of depression of the so-called "vital functions."

Collapse is a term loosely applied to more severe degrees of this condition, especially in cases in which marked depression occurs suddenly or an initially mild condition of depression rapidly gives way to a more pronounced state of depression.

As a result of observations made during the war in the trenches and clearing stations, it has become customary to classify shock as (1) early, primary, or immediate, and (2) late, secondary, or delayed. Primary shock refers to the depression of the vital functions which occurs soon after an injury has occurred and which is precipitated by the patient's noting the extent of the damage done or realizing the gravity of the condition in which he finds himself, whether the damage be really great or the condition of the patient really grave seeming to matter little as long as the patient thinks it is so. The "shell-shocked" individual during the late war presented essentially the same symptoms and signs in the absence of severe physical trauma as did his comrade who suffered severely in actual combat. Mild degrees of primary shock are noted in civil life in connection with violent emotions, such as, fear, rage, and grief. Primary shock is of relatively infrequent occurrence compared with secondary shock and seems to be particularly prone to occur under the influence of hunger and exposure.

Secondary shock may occur as a result of (1) a prolonged operation or a serious accident, (2) loss of blood (hemorrhage), (3) excessive or rough manipulation of the viscera, particu-

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larly pulling and dragging on the mesentery of the gut, and (4) the absorption of toxins, especially after abdominal operations on patients with suppurative peritonitis.

II. MECHANISM OF SHOCK AND COLLAPSE

Although various theories have been advanced to account for the clinical phenomena of shock on the basis of adrenal exhaustion, acapnia, and fatigue of the vital centers of the central nervous system by afferent pain stimuli, the only essential physiological phenomenon which has been demonstrated is deficiency of the volume of blood in actual circulation. Diminution in blood volume by exsanguination as a result of hemorrhage is a very obvious mechanism and either completely or partially accounts for by far the greater number of cases of shock and collapse. That shock may occur, however, without the loss of any blood either externally or internally is well understood.

In order to comprehend the mechanism by which diminution of blood volume may occur in the absence of actual loss of blood it is necessary to understand that normally there exists a very delicate balance between the amount of blood in the capillaries and the amount of blood in the rest of the cardiovascular system.

The amount of blood normally contained in the so-called "capillary bed," i.e., within the lumina of the capillaries throughout the body, though actually great, is nevertheless minimal, due to the tone of these minute blood vessels. The cubic capacity of the capillaries, however, is capable of undergoing rapid and enormous expansion under suitable stimulation; during active contraction and relaxation of muscular tissue the volume of this tissue may increase from 250 to 750 times, the increment being due entirely to capillary dilatation and ingress of circulating blood into the enlarged capillary bed. During certain types of shock there is a general capillary dilatation, and the patient actually bleeds into his own "capillary bed." The volume of blood which previously

filled the larger arteries and veins, being thus dissipated, these vessels tend to collapse, and the rate of blood flow within them is much decreased; the chambers of the heart accordingly fill and empty incompletely even in spite of a much increased cardiac rate. Capillary stasis, furthermore, rapidly brings about a peripheral condition of tissue anoxemia, and the acid waste products of incomplete combustion accumulate within the tissue spaces. These waste products increase the permeability of the capillary wall, and fluid escapes from the capillaries into the tissue spaces thus still further aggravating the primary diminution in available blood volume. Profuse sweating results, and the evaporation of sweat from the exposed surfaces of the body tends to reduce the general body temperature which has already become markedly depressed by virtue of compensatory vasoconstriction of the peripheral arterioles and venules, the tone of the arterioles and venules being under separate control from the capillaries as shown by Dale, Lewis, and others.

Dale, Laidlow, and Richards[1] have been able to produce in experimental animals a condition in all respects similar to clinical shock by the injection of the chemical substance "histamine." Whether histamine is the actual substance responsible for the development of shock in clinical cases is open to serious doubt, but Cannon[2] and Bayliss[3] produced evidence that some substance closely akin to histamine is found in injured tissue and when absorbed is capable of causing shock, as they have been able to produce experimental shock by allowing absorption to occur from a crushed limb in animals and have been able also to prevent or control the development of the same by preventing venous return from the part. This variety of experimental shock develops quite independently of the action of the central nervous system, as section of the nerve supply going to the injured member influences the course of events not at all.

Recently the hypothesis implicating such a histamine-like substance in the circulating blood as responsible for shock

has received considerable criticism. Smith[4] failed to find any such substance using direct methods, and Blalock and Bradburn[5] on the basis of determinations of the oxygen content of blood from various veins during shock found evidence strongly suggesting that generalized capillary dilatation does not occur, but merely capillary dilatation in the region involved by the trauma.

The mechanism underlying the production of shock as a result of the rough handling of certain viscera, traction on the mesentery, and section of large nerve trunks is apparently not one of capillary dilatation but rather one of widespread arteriole and venule dilatation. This type of shock tends to be minimal during deep general anesthesia, and also to cease with cessation of the stimulus; it must be regarded, therefore, as essentially reflex in character.

III. CLINICAL RECOGNITION OF SHOCK

Shock occurs clinically in a wide variety of degrees. In the *terminal* stage of shock the patient shows a profoundly apathetic mental reaction. The blood pressure, as previously mentioned, is low and steadily falling; the pulse is rapid and of small volume. The skin is either pale or slightly cyanotic and is covered with cold sweat. The respirations are rapid and shallow, and inspiration tends to be sighing in character. The limbs are flaccid, and there is little tendency to spontaneous movement.

In *mild* shock the circulatory system alone may be affected, the blood pressure being reduced, but in the mildest cases the pulse rate being relatively unchanged. The mental reactions of the patient may be unusually alert.

Between these two extremes occur many variations in the symptom complex, one set of symptoms being evidenced by one patient, another set by another, but always in conjunction with one degree or another of vascular depression.

IV. Treatment of Shock

Shock is, of course, a serious condition when definitely established and accounts for a considerable proportion of all surgical deaths.

A. PROPHYLAXIS: Though many patients are first seen by the surgeon after shock or even collapse has already developed and for such patients active treatment is all that can be considered, the prophylaxis of shock is a matter which is of considerable importance in the practice of surgery, surgery involving, as it does, the mechanical manipulation of tissue. Rough handling of tissues, sepsis, the use of strong antiseptics, undue exposure of tissues to the air, and tissue drying, loss of fluids, especially blood, loss of body heat, fatigue, excitement, and starvation, must all be avoided if shock is to be successfully averted.

B. THE USE OF WATER AND SALINE SOLUTIONS: As all shock, whether due primarily to actual loss of blood from the body, to bleeding into the patient's own capillary bed, or to profound vasodilation involving the arterioles and venules, is characterized fundamentally by a diminution in available blood volume, the essential indication in active treatment is for the addition of quantities of fluid to the circulation. In mild cases this addition of fluid may be satisfactorily effected by allowing copious amounts of water by mouth and by proctoclysis. Absorption of water from the gastrointestinal tract, however, occurs but slowly even under normal conditions and occurs more slowly or scarcely at all in the presence of venous stasis or tissue edema. Once the condition of shock has become firmly established the administration of fluids either by way of the intestinal tract of even by hypodermoclysis becomes relatively futile, because under such circumstances fluids actually pass out of the capillaries instead of being absorbed into them, and the addition of still more fluid to the tissue spaces simply serves further to increase the edema. In severe or well established shock the only means of.supply-

ing fluid that can possibly avail is, therefore, the introduction of them directly into the vascular tree, and in the severest cases the only fluid which will remain for a sufficient length of time within the vascular system to be of permanent value is blood itself, for, due to the increased permeability of the vascular endothelium, artificially compounded solutions diffuse into the tissue spaces almost as fast as they are introduced into the blood stream.

This is particularly true of normal saline solutions and the more complex solutions of organic salts sometimes called "artificial sera," of which Locke's solution and Ringer's solution are examples.

Ten per cent solutions of dextrose are more efficient in raising the blood pressure than saline solutions partly because such solutions are actually hypertonic and partly because the molecule of sugar is so much larger than the molecule of salt that it tends to remain longer within the vascular tree and thus serves to prevent rapid elimination of water either by diuresis or by osmosis into the tissue spaces. Sugar solutions, however, like salt solutions, are of only temporary value. If such solutions be used, insulin should never be added to, or injected in connection with them, for insulin tends not only to reduce the amount of sugar in the circulating blood, the presence of which in abnormally large amounts is precisely the state desired, but insulin also exaggerates diuresis and diffusion of water into tissue spaces, thus facilitating loss of water from the vascular system, which is precisely the effect not desired. Practically, sugar solutions are only slightly more valuable than salt solutions, as their action is only transitory.

c. The Use of Gum Acacia and Gelatin Solutions Intravenously: Attempts have been made at various times to devise solutions possessing enough of the fundamental characteristics of normal blood to make them efficient in more or less permanently increasing the blood bulk.

As has been thoroughly appreciated since the experimental observations of Scott[6] in 1916, the walls of the capillaries are

permeable to water and to crystalloids but not to colloids, the one exception to this rule probably being the capillaries of the liver. Evidence for the permeability to colloids of the capillaries in the liver is found in the presence of a certain amount of protein in lymph taken from the thoracic duct.

The regulatory mechanisms underlying the passage of water through the walls of capillary blood vessels consist of osmosis and diffusion. According to the laws of physical chemistry, when two watery solutions of different osmotic tensions are separated by a membrane permeable to water but not to the substances responsible for the osmotic tensions, water passes from one solution to the other, and the force exerted by the water in its passage through the membrane represents the difference in osmotic tension between the two solutions.

The osmotic tension exerted by normal blood serum can be relatively easily measured, using a mercury manometer and a gelatin membrane, as gelatin has the same permeability characteristic as the wall of a capillary blood vessel: it passes water and crystalloids, but not colloids.

The osmotic tension of serum, as thus measured, varies normally between 30 and 35 mm. of mercury. This, as will readily be appreciated, rather accurately represents capillary blood pressure values obtained experimentally; indeed, it is primarily the balance between the capillary blood pressure and the osmotic tensions of the blood colloids which determines the water content of the circulating blood under conditions of normal permeability. When the blood pressure is low water tends to diffuse into the blood stream from the tissue spaces; when the blood pressure is high the reverse tends to occur. Abnormally, in shock, the permeability of the capillaries is increased, and normal pressure relationships no longer obtain.

During the late war a very serious attempt was made to compound a fluid for injection into the blood stream which would possess a colloid content similar to that of blood and

by its colloid content would tend to maintain osmotic relationships and thus prevent rapid loss of water through the capillary wall.

Most proteins are unsuitable for intravenous injection because of their tendency to produce either hemolysis or anaphylactic phenomena.

It has been determined that gelatin in 6 per cent watery solution or gum arabic in 7 per cent watery solution closely fulfils the theoretical requirements. Gelatin, however, presents two rather serious incidental disadvantages which are generally considered to render it unsuitable for the purpose under discussion: (1) it is very apt to contain tetanus spores, and (2) it shows a distinct tendency to produce intravascular coagulation of blood. Gum arabic solution presents neither of these disadvantages to the same degree. This substance has been used both experimentally and clinically so extensively that a considerable amount of evidence has accumulated with respect to its value.

A simple solution of gum acacia, be it said in passing, cannot be used for intravascular injection, for though its colloid properties are similar to those of blood its tonicity is not the same, and the blood corpuscles undergo hemolysis, they, in contradistinction to the capillary wall of blood vessels, being not only impermeable to colloids but also to sodium chloride and other salts. For this reason gum acacia solutions must always be compounded in physiological saline solution, the so-called "gum-saline" solution, if untoward effects are to be avoided.

Bayliss[7] has been the especial proponent of gum acacia solutions in the treatment of shock and hemorrhage. He believes that such solutions are both non-toxic and efficient when properly prepared and injected and presents evidence to support his view both from the bedside and from the experimental laboratory. In support of the contentions of Bayliss is the experimental work of Barthelemy,[8] Brodin, Richet, and Saint-Girrons,[9] Rouse and Wilson,[10] and Mann.[11]

Additional favorable clinical reports have been made by Keith[12] and by investigators from the Mayo Clinic, Adson and McIndoe[13] and Huffman.[14]

Unfavorable reports on the use of gum-saline solutions have not found their way into the literature in any considerable numbers. The Council on Pharmacy and Chemistry of the American Medical Association condemned the method mainly because gum acacia produces profound disturbances in the physicochemical equilibrium when added to blood in vitro. Bernheim[15] and Lee[16] reported untoward reactions as the result of injection of gum-saline, and Appelmans,[17] Hanzlik, DeEds, and Tainter[18] and Kruse[19] have discussed possible harmful actions of such solutions.

Because, presumably, of the assertion of Davis that the infusion of gelatin solutions tends to favor intravascular clotting little attention either experimental or clinical has been paid to this particular type of blood substitution solution. Wolfson and Teller,[20] however, have recently presented evidence to show that in animals gelatin solutions may be used with beneficial effects apparently similar to those claimed for gum-saline solutions and that intravascular coagulation is not particularly favored thereby.

In the presence of contradictory evidence as to the value of any surgical method, such as has been presented with respect to both gum-saline and gelatin solutions when used as substitutes for blood, the surgeon should be exceedingly wary. In general, it may be assumed with some accuracy that only those observers who are more or less enthusiastic about new methods write about them, and enthusiastic persons are proverbially given to unconscious exaggeration. The individual who uses a new method critically and without any preconceived conviction and who, therefore, is in the best position to put into writing a just evaluation of his results when he has arrived at well-founded conclusions is usually either too busy or too disheartened to report unfavorably.

The fact that these blood substitution fluids were used rather extensively by numbers of surgeons during the war

and were subsequently abandoned, even while the need of solutions possessing their supposed beneficial characteristics was most pressing, speaks rather eloquently as to their general unsuitableness and inefficiency.

In fairness, however, to the entire subject of the artificial preparation of substitutes for blood, it should be said that undoubtedly the time will eventually come when an efficient substitute will be found, and in the meantime much credit is due those investigators who have already pioneered in the field. Furthermore, it is quite possible, as some of the ardent advocates of gum-saline solutions have urged, that some of the discredit which has been cast upon the use of gum Arabic has been undeserved and is directly traceable to the use of an improperly compounded product.

According to Telfer,[21] Bayliss,[22] and Osterberg[23] and Huffman,[24] the considerations of importance in compounding a suitable gum-saline solution are apparently as follows:

1. Only lumps or "pearls" of gum acacia of the greatest purity should be used in the preparation of the solution; these should be clear and nearly colorless. Powdered preparations are generally worthless.

2. The addition of calcium to gum Arabic solutions is not necessary, for the gum itself usually contains enough of this substance.

3. The use of distilled water of considerable purity is highly desirable; the most careful investigators have used freshly prepared and triply distilled water.

4. As gum acacia may contain resistant spores the solution should be autoclaved before use.

5. A biological test for toxicity is advisable before using solutions clinically; larger doses than are planned for injection into man are first given to experimental animals.

A suitable technique for the actual preparation of a gum-saline solution is the following:

1. Weigh 480 gm. of acacia and 72 gm. of sodium chloride and place in a 4-l. flask of resistance glass.

2. Add about 500 c.c. of freshly prepared triple-distilled water and stir with a glass rod over a hot water bath until as much as possible of the acacia has been dissolved; decant the resultant fluid into an 8-l. flask; add

another 500 c.c. portion of water and repeat the process. Continue this until all of the acacia has been dissolved, and make up the resulting solution to a full 8 l.

3. Autoclave the resulting turbid solution.

4. Filter under sterile conditions through a Buchner funnel fitted with a soft filter paper.

5. Re-sterilize the solution twice in the autoclave and allow any flocculent material which forms as a result of this procedure to settle to the bottom of the flask.

6. Siphon off the clear supernatant fluid into flasks of suitable size under sterile precautions, plug the flasks with sterile cotton or gauze and set aside until required. The solution remains suitable for use for several months.

Injection of gum-saline solutions should proceed slowly, not more than 20 c.c. being introduced into a vein per minute.

D. THE USE OF BLOOD TRANSFUSION: Inasmuch as the following chapter is devoted to the subject of blood transfusion most of the discussion which might otherwise have been well undertaken at this place will be found in succeeding pages. In general, however, it may be stated that although blood transfusion is specific in cases of shock due to hemorrhage, its value in shock secondary to capillary dilatation is quite doubtful, and in the treatment of shock secondary to arteriole and venule dilatation the administration of blood transfusion is also of questionable efficacy. The reason seems to lie in the fact that though there is undoubtedly a deficiency in the total volume of circulating blood this phenomenon is more or less accidental, the fundamental derangement being the peripheral changes previously outlined and being essentially physicochemical in nature. The filling of the cardiovascular tree with blood or any other suitable medium is of value insofar as it tends to support the circulation, but, after all, such treatment is merely symptomatic and unless conditions favorable to a resumption of normal peripheral vascular tone can be achieved, the abnormal peripheral physicochemical changes will ultimately be sufficient of themselves to cause death.

Early hot saline infusions undoubtedly are of greater value than delayed blood transfusions, because the fundamental aim of the treatment of shock is preventive. When recognized early, shock readily yields to ordinary supportive treatment, whereas when recognized late and in its firmly established form any and all kinds of treatment will probably fail.

E. THE USE OF HEAT: As shock and collapse represent fundamentally a depression of the vital functions, and because the activity of the vital functions is indissolubly connected with combustion and the formation of heat, one of the most important considerations in the treatment of these conditions is the maintenance of the body heat at or near a normal level. This may be achieved in a number of different ways. One of the most obvious is the application of external heat to the body of the patient making use of hot-water bottles, electric heating pads, the electric light tent, or other suitable measures and concentrating one's effort especially on the extremities of the patient. Internally heat may be conveniently supplied (1) by means of hot drinks: the stomach may be virtually converted into a hot water bottle lying against the liver and great vessels, (2) by means of hot infusions: heat is supplied directly to the circulating blood, and (3) by means of diathermy.

Crile and Higgins[24] advocate the use of diathermy as one of the most potent factors at the command of the surgeon in the treatment of shock and hemorrhage. They cite the fundamental chemical law that within certain limits an increase of 1° c. in temperature hastens chemical activity by 10 per cent, and ask what stimulant or drug has a metabolic effect at all comparable to this. The electrodes of the diathermy apparatus are applied so as to concentrate heat in and over the liver and the great vessels, aorta, vena cava, and vena porta.

F. THE USE OF DRUGS: 1. *Morphine:* Generally speaking, the value of drugs in the treatment of shock and hemorrhage is virtually nil with the single exception of morphine. Morphine is, of course, fundamentally a depressant drug when administered in ordinary doses and for that reason might on casual

consideration seem to be contraindicated, inasmuch as the vital functions are already too far depressed in shock. The unfavorable influence of anxiety and fear on the development of shock has, however, been mentioned, as well as the fact that patients in shock are frequently quite acute mentally. The sedative influence of relatively large doses of morphine on the mental processes of the patient far outweighs any accidental depressant action of a physical nature which may accrue, and this drug is actually of the utmost value for this reason.

Drugs classed as "cardiac or respiratory stimulants" are without exception of little or no value in the treatment of established shock, because (1) respiratory failure is always secondary to cardiovascular failure, and cardiovascular failure in turn is due to no essential inadequacy of the cardiac mechanism itself but rather to peripheral circulatory deficiency, and (2) such drugs as are available are actually inefficient in shock and collapse.

From theoretical considerations it might be supposed that the drugs commonly used to increase the blood pressure by direct action on the arterioles and venules, i.e., the vasoconstrictor drugs, might be of value in the treatment of shock.

2. *Epinephrine:* Epinephrine is the most active of the blood pressure raising drugs which depend upon this vasomotor mechanism, and as has been shown by Pilcher, Wilson, and Harrison,[25] is capable of increasing the cardiac output from 10 to 50 per cent when injected into normal animals. According to the experimental findings of Rouse and Wilson,[26] however, animals subjected to hemorrhage or prolonged ether anesthesia show a diminished response to the action of the drug: the more exsanguinated, or the more deeply anesthetized the animal, the less efficient is the drug, frequently three or four times the normal amount being inefficient. When it is given in sufficient quantities a typical rise of blood pressure is noted even in the presence of hemorrhage according to Pilcher and his associates,[25] but the duration of the effect is not more than seven minutes, and at the end of this period of elevation the blood

pressure and cardiac output show a tendency to fall even below the initial level and to remain there.

These characteristics of epinephrine render its use in the treatment of shock virtually valueless except in cases in which it is given as a temporary measure during preparations for the more valuable procedures previously discussed, especially transfusion.

3. *Ephedrine:* In many or most of its pharmacological properties ephedrine closely resembles epinephrine. It is an alkaloid derived from the Chinese "ma huang" or Ephedra vulgarus. The active principle of this small, practically leafless, shrub was isolated in an impure form by Yamanashi as early as 1885, but only in 1923 was a preparation made of sufficient purity to permit a determination of its chemical structure; credit for this valuable work belongs to Chen.[27] The crude drug has been known in China for at least 5000 years.

According to Chen and Schmidt[25] the essential physiological action of ephedrine is that of raising the blood pressure by a mechanism of peripheral vasoconstriction and cardiac stimulation. This effect is seen whether the drug be taken by mouth or injected by hypodermic needle. Although the effect on blood pressure is identical with that of epinephrine the duration of the effect of ephedrine is much longer than that of epinephrine, twenty minutes or more in experimental animals.

This characteristic action of ephedrine on the circulation is seen, however, only when the vascular system is functioning in a relatively normal manner and when the drug is given in not too large doses. Toxic doses when administered to the intact animal may lead to cardiac failure, and the isolated heart when perfused with solutions of too great concentration is thrown into fibrillation and soon ceases to beat at all. In the dog a toxic action results from the administration of 40 to 65 mg. of the drug per kilogram of body weight.[29,30]

In well established shock and hemorrhage the action of ephedrine is not at all such as might be expected from a con-

sideration of its normal action. Chen[31] has shown experimentally that when injected into animals having lost 25 per cent of the total blood volume or animals much depressed by the action of circulatory poisons, such as histamine and peptone, ephedrine may not only fail to raise the blood pressure but may actually cause the death of the animal. Fatal results are especially apt to follow the administration of the drug after a more or less prolonged period of continued low blood pressure (thirty minutes), and this may result even though the dose of ephedrine is relatively small (1 mg. per kilogram).

As Chen and Schmidt say (*loc. cit.*) ephedrine is certainly not to be considered a specific for shock or hemorrhage. It is of no value in cases in which a preliminary injection of epinephrine fails to produce a satisfactory effect and is capable of producing a lethal result when employed after shock or hemorrhage have become well established.

In connection with efforts to provide adequate volume to the circulating blood, especially in connection with transfusion, the drug probably has a value similar to that of epinephrine and under these circumstances its judicious use may be distinctly indicated.

4. *Pituitrin:* Aside from its action on the uterine musculature, in which action pituitrin is virtually specific, pituitrin would seem to be a very unreliable pharmacological agent and a much over-rated one. It is said to have a definite vasoconstrictor effect on the peripheral blood vessels generally, and therefore to be a useful agent in increasing the blood pressure; but experimentally this certainly is not invariably the case, and occasionally actual depressions of the blood pressure have been noted even in apparently normal animals. In any case, the blood pressure raising effect of the drug is only temporary. Possibly the occasional depression of blood pressure which is seen is dependent upon cardiac dilatation, which, according to Oliver and Schaefer,[32] occurs immediately after injection of the drug. In general, the vasoconstrictor effects of pituitrin are not nearly so great as those of epi-

nephrine and adrenalin, and in view of its unreliability as a vasoconstrictor it is correspondingly less efficient.

5. *Caffeine, Camphor, and Strychnine:* Caffeine, camphor, and strychnine are three drugs which formerly enjoyed some favor in the treatment of vascular depressions, but which, when subjected to the acid test of examination by experimental methods, have proved to be quite worthless as blood pressure raising agents.

Caffeine, as shown by Pilcher, Wilson, and Harrison,[25] not only fails to increase the cardiac output, but actually diminishes it; the greater the dose of caffeine-sodio-benzoate given to dogs, the greater is the reduction in cardiac output.

Camphor has been shown by Bodo[33] and Winterberg[34] to be not a vasoconstrictor but actually a vasodilator unless sufficient doses be given to cause convulsions; the coronary vessels share in the general vasodilatation. Camphor also acts as a depressant to the cardiac musculature.

Strychnine was formerly used as a cardiac tonic, but no tonic effect has ever been demonstrated experimentally, although Bodo[33] attempted to obtain such an action from heart-lung preparations in the dog.

6. *Alpha-lobeline:* Alpha-lobeline is one of the four alkaloids which have been definitely isolated to date from *Lobelia inflata.* Dresser[35] in 1889 first isolated the substance in relatively pure form as a platinum double salt, but in 1921 Wieland, Schoepf and Hermsen[36] were able to isolate a pure hydrochloride and establish the empirical formula which is at present accepted as correct.

Alpha-lobeline is apparently the most active alkaloid of lobelia. It has gained a foothold in therapeutics largely as the result of the experimental investigations of Wieland and Mayer[37] who found that in certain stages of depression of the respiratory center induced by urethane, morphine, and chloral hydrate in pigeons and rabbits excitation could be produced by the administration of the drug. These authors recommended subcutaneous or intramuscular injection of alpha-lobeline

rather than intravenous administration because when given by the latter route the drug sometimes caused tonic and clonic convulsions, induced direct and reflex depression of the respiratory center, and produced harmful affects on the cardiac muscle.

Further and more critical studies of the action of alpha-lobeline, though they have not been in essential conflict with the earlier studies which dealt with only slight degrees of depression, have served to modify profoundly the initial optimism of users of the drug in combating profound depressions. King, Hosmer, and Dresbach[38] have produced experimental evidence to show that in dogs, cats, monkeys, and rabbits considerably depressed by various drugs or by increased intracranial pressure, stimulation of respiration by alpha-lobeline is either slight or actually absent and the blood pressure, which under lesser degrees of depression is elevated, becomes under these circumstances actually depressed. The blood pressure decreases at times were sufficient to cause the death of the animals. Alpha-lobeline, like adrenalin, is capable of producing hyperglycemia. King, Hosmer, and Dresbach have collected a large number of experimental and clinical reports, especially from the German literature, confirming their own observations.

Whitehead and Elliott[39] studied the effect of alpha-lobeline on the mammalian heart by means of electrocardiographic tracings and found that whereas relatively small doses of the drug resulted in a lowering of the heart rate, somewhat larger doses increased the rate and regardless of the dose a 2:1 heart-block was frequently induced.

Obviously a drug which fails to influence the respiratory function favorably and which reduces the blood pressure and commonly produces a 2:1 heart-block in depressed patients is a very poor one to use in well established cases of shock.

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CONTRIBUTION TO THE MODERN METHOD OF

DIAGNOSIS AND TREATMENT OF THE SO-CALLED SCIATIC NEURALGIAS

CASE REPORTS*

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NEW YORK, N. Y.

THAT pain in the lower extremities travelling along the posterior aspect of the thigh is generally spoken of as sciatica needs little discussion. That painful conditions of the lower extremities ill-defined in character and distribution are often described as sciatic neuralgias is quite true. That the origin of such pain is referred either to pathological conditions of the vertebral column or to recognized foci of infection is the generally accepted view. That many painful conditions of obscure origin remain undiagnosed and are treated symptomatically by the most varied methods, including the use of narcotics, is most certain. That the use of narcotics is the uniformly advocated palliative treatment in many undiagnosed cases and is most unfair to the patient cannot be denied. To add further means of diagnosis of the so-called sciatic neuralgias and contribute to their treatment by nerve-blocking are the objects in which we are particularly interested in this paper.

Encouraged by the results obtained with nerve-blocking in cases of trifacial neuralgia, we endeavored to apply identical principles to painful conditions of the lower extremities. Investigation of actual physical disorders assumed a wider range and covered a much broader territory than when painful conditions of the face are dealt with. Allowance was also made for individual psychology. All our patients were submitted to a complete physical examination; blood test and microscopic examination of smears and excreta were made when deemed important aids. As a routine procedure, roentgenograms of the spine were obtained from such angles as would render the bony structures of the vertebral column easily visible in all positions. In certain cases x-rays were taken of the parts affected by the neuralgia, thigh, knee, leg, foot and ankle.

Our method of diagnosis consists in detecting the paths of painful impulses by producing vibrations which may be transmitted deeply through a small instrument called electric percussion hammer. This is, we believe, the first time that an electric vibrator has been used in the diagnosis of neuralgic pain. Tracings were made on the surface of the skin with mercurochrome. Photographs were taken and the tracings compared with the anatomical distribution of the nerves of the lower extremities from their exit from the intervertebral foramina to their terminal points. Comparison of the tracings with the vascular distribution over the limb was also attempted. The nerves were blocked individually by the paravertebral technique, so as to include the rami communicantes. Alcohol and

* Read before the American Society of Regional Anesthesia at its stated meeting of October 7, 1930 at the New York Academy of Medicine.

neocaine solutions were used in varying concentrations and amounts.

Electric Percussion Hammer: This little instrument was devised by one of us (Greene) following the general principles of the electric vibrator. It has been of great help not only in confirming the diagnosis of sciatica, but in detecting the nerves which were suffering more or less from disturbances in their conductivity. These disturbances, whether of toxic origin or due to mechanical irritation, may have been in the sensory fibers or in the network of sympathetic elements accompanying the arteries. Pressure exerted by the vibrating disc is transmitted to the deep structures and awakens painful stimuli whenever these vibrations make or break contact with a diseased nerve or one belonging to a diseased circuit. After each blocking the use of the hammer made it possible to supervise the work done by the alcohol-neocaine solution, thus aiding in the correct blocking and reinjection. Our experience with the electric percussion hammer is not sufficiently long and varied to permit us to draw conclusions as to its clinical value in general neurological diagnosis, but the services it has rendered us are worthy of consideration.

Types of Pain. Unlike the sensory manifestations associated with trifacial neuralgia, different from the three characteristic features of trifacial neuralgia, namely, suddenness, severity and brevity of attack with complete remission, most of our patients complained of continuous pain, interpreted differently by different individuals. In some cases, the pain was intermittent, but it was generally described as twitching, stiff, sharp and aching like a tooth. Some of the painful conditions were said to be spasmodic and cramp-like. In the majority of cases the onset, although without apparent cause, coincided with some physical exertion.

Duration of Pain. In the cases reported to illustrate this paper the persistency of the pain before the blocking varied from two weeks to twelve years. There were 5 cases in which the pain had been present for less than a year.

Distribution of Pain before Blocking. In all cases the electric percussion hammer revealed the presence of sore spots in the lumbar region, occasionally spoken of as around the kidney region. The sore spots could be traced along lines which radiated downward toward the thigh, leg and ankle; in most cases also along the outer and anterior surfaces of the thigh, occasionally reaching as far as 30 cm. below the knee. In a few instances it was possible to trace the pain up to the big toe following the inner aspect of the leg and foot.

Foci of Infection. In all cases except 3, infection was present in either the facial sinuses or genitalia or both. Infection of sinuses and teeth was found in 2 cases, sinusitis alone was present in 1. In comparing these foci of infection with x-ray findings in individual cases, it was found that 7 out of the 10 patients showed moderate productive changes somewhere in the spine in the neighborhood of the intervertebral foramina of the affected nerves, changes suggestive of hypertrophic osteoarthritis. In 9 out of the 10 reported cases urinalysis was negative except for traces of albumin, casts, indican, squamous epithelial cells, the presence of which did not indicate absolutely any infection of the kidneys.

Nerves Blocked. In comparing the tracings with the nerve paths, using the electric percussion hammer as a guide, it was possible to identify the second and third lumbar nerves and in many cases the first sacral nerve as well. The second sacral nerve was found to be a possible factor in 2 cases out of the 10 here reported.

Solution Injected. It was not possible to determine beforehand the exact amount of neocaine or its concentration in alcohol to be injected in all patients and thus arrive at a general formula. It was necessary to feel our way and consider each individual case. Thus, using our judgment and previous experience in nerve-blocking, we have been led to inject not more than

5 c.c. of 95 per cent alcohol in any individual in no greater concentration than 33 per cent in 1 per cent neocaine solution. The doses have varied per nerve from 2 to 10 c.c. of the mixture of alcohol and neocaine.

Sensory Manifestations at the Time of Blocking. Most of the nerves distributed to the lower extremities are mixed. The result of their blocking must of necessity be clinically different from those following a trigeminal block. Distortion in the perception of sensory impulses from the periphery is almost similar, but owing to such distortion the normal motor function is disturbed, reactions are occasionally severe and temporary paralysis may follow poor technique. As a general rule, weakness of the lower extremity was evidenced when any of these nerves had been blocked, the lumbar nerves being arranged in plexus form. In no case did it assume the character of paralysis, the strongest reactions lasting only a few hours.

In the course of the injection, as soon as the solution reached its aim, a burning sensation was felt locally and seemed to travel along the injected nerve to the periphery. In other words, paresthesias were observed in the territory supplied by the nerves blocked. The burning sensation disappeared almost instantly, that is, soon after the injection was stopped and the paresthesias were replaced by a sensation of warmth, swelling and heaviness, sometimes described as stiff or lump-like. These sensory changes were interpreted differently by different individuals, but they all were agreed upon the feeling of warmth and swelling. Some patients complained of burning sensation which lasted from twenty minutes to three days. We cannot say whether it really burned or whether the disturbance in the normal balance of peripheral sensations created in them a distortion of perception which made them interpret numbness and heat or either as a burning pain. Of all the patients blocked for trigeminal neuralgia no complaint of post-blocking burning sensation is heard when the technique is accomplished with ease and the injection made with precision. Numbness, stiffness, weight and swelling are the sensations most generally described after a trigeminal block. Again we feel that comparisons of post-blocking reactions ought not to be established between a trigeminal block and a paravertebral lumbar or sacral block with alcohol.

Circulatory Changes. In all the cases coming under our attention, of which the present report is composed of only a small number, there was a marked difference of surface temperature between the two limbs. This difference could be detected not only by the thermometer and the thermocouple, but also by the hand. The affected limb was pale, cold and occasionally clammy; the temperature readings varied occasionally to as much as $3.2°C.$ at the time of examination. Immediately after the alcohol-neocaine block the skin temperature on that side invariably rose to levels above the opposite side. Whether the pain travelled along the mixed nerves through its sensory fibers or through the sympathetic system or through both has not yet been proved. But the fact is that after the blocking of the spinal nerves by the paravertebral technique, there are subjective as well as objective signs of a rise of temperature, as evidenced by the sensation of heat or warmth announced by the patient and the skin temperature readings. It may be argued that the simultaneous blocking of the rami communicantes is responsible for the vasodilatation observed. Blocking of the great sciatic nerve at the great sacrosciatic foramen is also followed by vasodilatation.

The nature of the mechanism that causes the pain to disappear is probably similar to that which abolishes the transmission of painful impulses during surgical operations. Dilatation of the vasa nervorum may also be one of the gears of such mechanism, the sympathetic block and its resulting vasodilatation acting as a resistance coil along the path of painful impulses and modifying the perception of peripheral sensations.

Sensory Manifestations Post-blocking. Sensory disturbances of specific character followed each alcohol block. They could

sensory transformations without the assistance of palliative measures. In 2 cases, however, no treatment was given.
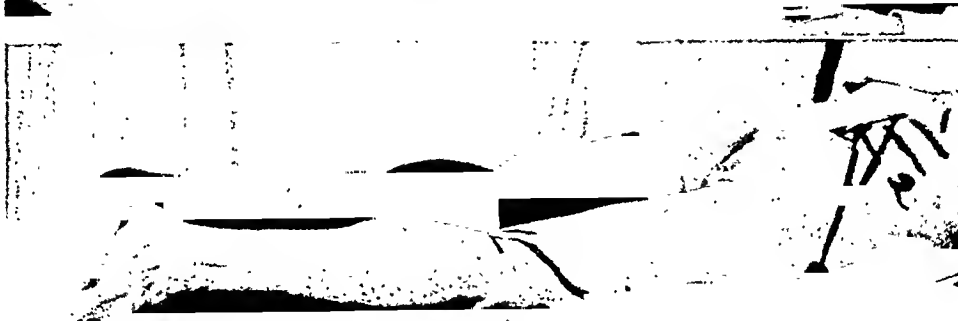

FIG. 1.

FIG. 2

FIG. 1 (Case 1). Tracings in right lumbosacral region indicate zones particularly complained of, being the origin of pain. The tracing along lower limb is path of painful radiations. Note tender area in plantar region (sacral origin).

Note: In this and all the other photographs the dots represent sites of greatest tenderness, the arrow the direction of radiating sensations, and the lines, the path of painful impulses. All tracings mark painful or tender zones revealed by the electric percussion hammer.

FIG. 2 (Case 1). Tracing of painful zones, as revealed by electric percussion hammer, on inner aspect of lower limb. (L 2 + L 3 involvement.)

not be explained. They could not be controlled, but subsided gradually and in cyclic order. The burning sensation seemed to be predominant following these injections and its distribution along the paths of the nerves blocked. Its duration varied considerably from a few days to several weeks, being replaced by that of pins and needles and finally by numbness.

Associated Treatment. Many of our patients received post-blocking treatment as a palliative aid to the sensory disturbances. These treatments consisted in the use of diathermy, infra-red rays and massage. Those who were given diathermy were deemed to fare worse; infra-red rays were beneficial to others, while light massage was also considered a soothing procedure. Comparison was not made with control subjects; that is to say, no patient was left alone to go through the various

CASE REPORTS

CASE 1. M. T., male, seventy-two years of age, tailor, first seen in April, 1929, complained of severe pain in the right leg and foot of four days duration. The patient was in bed when first seen. Past history revealed rheumatic condition associated with sore throat and frequent colds. Extraction of diseased teeth is said to have helped the pain slightly.

Without warning while at work, the patient's right leg sagged under him. He felt a sharp pain starting above the right kidney region and radiating rapidly toward the inner surface of the thigh. Pain seemed to disappear there and reappeared on the inner surface of the ankle joint. He was then taken home in a state of collapse. A diagnosis of rheumatism and sciatica was made by the family physician who prescribed aspirin and liniments. There being no results in four days the patient was referred to us.

General physical examination led to the diagnosis of chronic nephritis and neuralgia of the anterior crural and external cutaneous nerves of pyotoxic origin with focus in prostate. For a period of one month symptomatic treatment consisting of diathermy, galvanism, massage and baking did not produce the slightest change for the better. It was then decided to block the nerves supplying the painful areas. The electric percussion hammer, in tracing the painful zones, detected the paths of painful impulses.

On May 17, 1929 the third lumbar nerve on the right side was blocked by the paravertebral technique with a mixture of 95 per cent alcohol and 2 per cent neocaine in the proportion of 1 to 2. The patient immediately felt a sensation of heat and weight (lump-like) where pain existed. Pain on the inner aspect of the thigh and ankle disappeared, but that on the lateral aspect of the thigh still persisted. Because of the patient's age it was decided to block the external cutaneous nerve (second lumbar) three weeks later, thus allowing the patient to recuperate from the first blocking.

The patient's condition rapidly improved and five weeks later he walked into Dr. Labat's office for the purpose of completing the treatment. The second lumbar nerve was then blocked with a solution similar to the one used before. Pain subsided instantly except at a point about 3 in. above the knee. Patient left in good condition. This injection was followed by a spasm of the abdominal muscles which suggested that some of the solution had reached the retroperitoneal tissue. This spasm or rigidity of the abdominal wall on the injected side gradually subsided. Patient is still well, seventeen months after the blocking; his general condition is excellent. He takes daily walks and attends to his home occupation without difficulty. There may still be a sensitive spot above the knee, but this does not inconvenience him in any way.

CASE II.   R. J., female, aged fifty-two years, housewife, first seen on July 8, 1929, complained of severe pain in the back, on the left side, radiating downward to the lateral surface of the thigh; duration six days. Family history irrelevant; past history negative except for diseases of childhood.

For the past year or so patient felt more or less constant pain all over the body. As it was not persistent, she paid little attention to it.

Ten days before consulting Dr. Greene, without apparent cause, an acute pain developed in the lumbar region. Rubbing with a liniment gave no good result. The pain was severe right from the start and continuous in character. The family obstetrician was called who after a more or less perfunctory examination suggested that the pain might be due to a "dropping of the genital organs." He prescribed some analgesic powders in addition to the liniments used before. After two days of suffering, the patient decided to consult Dr. Greene who made a complete physical examination. Urinalysis was negative, as was also the blood chemistry and the Wassermann test. X-rays revealed no pathology in lumbar and sacral and pelvic regions. Diagnosis was made of external cutaneous neuralgia of infectious origin with foci in tonsils, sinuses and cervix uteri. Possibly reflex irritation of first and second sacral nerves.

July 11, 1929 blocking of s 1 and s 2 with 95 per cent alcohol and 1 per cent neocaine in the ratio of 1 to 2 was made by Dr. Labat. Five minutes later the electric percussion hammer revealed pain still present in the lateral surface of the thigh and over the spine. The second lumbar nerve was then blocked. This was followed by a sensation of pins and needles in the thigh on the side blocked, the patient complaining of some pain in the region of the spine; a subcutaneous injection of 1 per cent pure neocaine was made in the sacral region. Pain gradually subsided.

Her general condition was good and the pain had completely disappeared when she was seen four days later. She had been able to sleep without morphine which had been used prior to the nerve-blocking. She left for the mountains for two months' rest. Six months later, patient reported in excellent condition. No motor disturbances in leg, no rigidity or pain of any kind, she is able to perform her household duties without the slightest difficulty. There are no sensory cutaneous changes, either in the leg or in the spinal region.

CASE III.   P. R., male, forty-two years of age, electrician, works on scaffolds and lifts heavy armatures, first seen in May, 1929, complained of sciatica in right leg; duration one year.

After lifting a heavy object, patient felt a sharp pain in his lumbar spine. Consulted a physician who diagnosed his case as a sprain

and strapped him. This relieved him for a few hours. Two days later a sharp pain in the right leg developed. He was treated by numerous physicians and attended several clinics where he received treatments consisting of diathermy, massage, stretching, hot iron skin cauterization, etc. He remained in one hospital for two weeks, in another for one week where his case was studied and diagnosed as sciatica. Treatment administered along these lines did not produce the slightest improvement. Pain was so severe that he was compelled to drop his work and remain without employment for the past six months.

General physical examination led to the diagnosis of neuralgia involving some of the roots of the small and great sciatic nerve. Focal infection in facial sinuses and prostate. X-rays revealed no injury or disease in the lumbar and sacral spines, or in other bones of pelvis or hip joint. Immediate treatment of genitourinary condition and sinuses cleaned. General condition markedly improved.

On September 20, 1929 blocking of s 1 on the right side was made with 8 c.c. of a mixture of 95 per cent alcohol and 1 per cent neocaine solution in equal parts. Paresthesias were obtained during the injection along the territory supplied by s 1. On November 9, 1929 patient said he had returned to his usual occupation after one week's rest at home. The pain had disappeared in the morning following the blocking. Six months later patient's condition was excellent. The electric percussion hammer revealed no tenderness along any of the nerves of the lower extremities. Patient is still free from pain. Occasionally has slight disturbances brought about by weather conditions.

CASE IV. B. S., male, aged fifty-five years, truck driver, lifts very heavy crates, was first seen on October 27, 1929. He complained of pain in the back radiating toward the hip, knee and leg; duration two weeks. Past history revealed that twelve years ago patient was operated upon for gastric ulcer; this was followed by a postoperative hernia. Seven years ago had compound fracture of left leg. About two weeks ago, on awakening patient had a severe pain in the back, especially on the right side, radiating towards the hip and leg. The pain was so severe that the patient's leg gave way under him. The pain was of spasmodic type and twitching in character. The pain became more aching and more steady in the

back and hip joint on the day he came to the office for consultation.

General physical examination revealed pussy sinuses and marked tenderness in the region of the second lumbar vertebra radiating toward the acetabulum and along Poupart's ligament. The tenderness reappeared on the right thigh about 10 cm. below the groin, then again about 10 cm. above the knee more to the median line of the limb. At that point the pain disappeared and reappeared about 10 cm. above the ankle joint. There was but very little pain on raising the right leg. *X-ray examination* revealed moderate hypertrophic osteoarthritic changes in the lumbosacral region. Prostatic smears examination showed pus cells about 200 to field or 50 per cent, no gonococci, squamous cells. Diagnosis of external cutaneous neuralgia was made with focus of infection in sinus and prostate.

October 30, 1929, the second lumbar nerve on the right side was blocked with 95 per cent alcohol and 2 per cent neocaine in the ratio of 1 to 2, 3 c.c. being injected near the nerve. This was followed by a slight sensation of stinging pain along the path of painful impulses. One half hour later the patient announced that his pain had completely disappeared but that there was a funny sensation present in the back and on the side of his leg. October 31, 1929, the painful area was retested with the electric percussion hammer and revealed absence of pain except above the ankle where some tenderness still persisted. Slight tenderness was also noticed on the lateral aspect of the thigh. March 24, 1930, patient had perfect motion. There was a slight pain on bending, just directly above the acetabulum, but patient was able to perform his work without the slightest difficulty in lifting heavy bundles; all objective symptoms had completely disappeared.

CASE V. I. H., male, fifty years of age, no occupation, owner of silk mill, was first seen on October 26, 1929. He complained of pain in the back, of twelve years' duration. The patient traced his pain to the day when he removed a cake of ice from the wagon. He then felt a sharp pain and was unable to straighten himself. Since that time the pain appeared and disappeared at irregular intervals. At times the attacks were severe; very frequently, they came early in the morning and compelled him to remain in bed for as long as a

week, at certain times. He consulted many physicians who diagnosed the case as lumbago and prescribed no medication but the wearing

and third lumbar and first sacral nerves on the left side with 95 per cent alcohol and 2 per cent neocaine in proportion of 1 to 2 was done
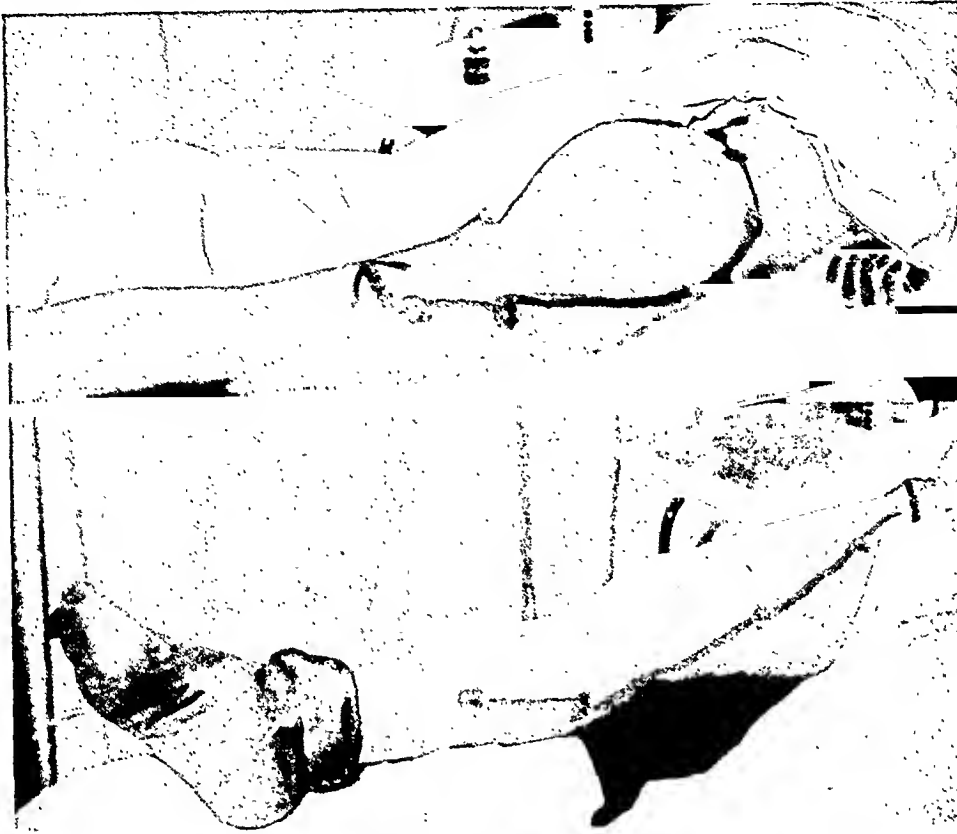

Fig. 3.

Fig. 4.

Fig. 3 (Case VI). Tracing of painful zones and radiations from lumbosacral region to middle portion of posterior aspect of thigh. Note arrow shooting higher. (L 2 + L 4 involvement.)

Fig. 4 (Case VI). Tracing on anterior and medial aspects of right lower limb of tender zones directly connected with zones shown in Fig. 3. Note and compare tracings of Figs. 3 and 4 with those of Figs. 1 and 2.

of a flannel belt. This did not help and his condition seemed to be worse when we first saw him.

General physical examination revealed the presence of foci of infection in the maxillary sinuses and the tonsils which were cryptic and full of pus. The prostatic gland was swollen and painful. Examination of the painful areas with the electric percussion hammer revealed tender spots on the left side, in the region of the fourth lumbar vertebra radiating downward toward the sacrum and laterally towards the hip joints. Diagnosis was made of lumbosacral neuralgia of obscure origin complicated by focal infection in tonsils, sinuses and prostate. *Radiographic examination* showed the presence of lipping of the bodies of the eleventh and twelfth dorsal and first, fourth and fifth lumbar vertebrae indicating productive osteoarthritis. No evidence of injury or disease in cervical or upper dorsal spine.

November 6, 1929, blocking of the second

by Dr. Labat. After blocking L 2 the pain disappeared on the side of the hip. After the blocking of L 3 the pain subsided on the lateral aspect of the thigh, but still persisted in the leg. This pain was controlled by blocking S 1. Immediately after, the patient felt a burning sensation over the entire limb. Retesting of painful areas showed disappearance of preoperative symptoms. On June 6, 1930, the patient reported through a friend that the pain had disappeared and that he was in excellent condition and very busy. It was not possible for him, through pressure of work, to come to the office for re-examination.

CASE VI. G. H., female, twenty-nine years of age, housewife was first seen in November 7, 1929. She complained of severe pain over the right kidney region radiating downward toward the thigh. Past history revealed that in 1926 patient was operated upon for appendicitis. A small abdominal tumor is said to have been removed at that time.

During the latter part of her second pregnancy the patient complained of severe pain in the back, and the doctor thought that the pain was probably due to the position of the baby which was causing a pressure on a nerve. After confinement, the pain eased somewhat but returned a few months later with increased severity. At present, it is a continuous aching pain, the attacks being intermittent and quite severe. There is no relation between partaking of food or weather changes and the pain.

General physical examination led to the diagnosis of chronic nephritis complicated by secondary anemia (hemoglobin 50 per cent), ulceration of cervix uteri, external and internal hemorrhoids. Right ovaritis and neurasthenia of the depressive type. Neuralgia of L 2 and L 3. *Radiographic examination* was negative as far as the pelvis and chest were concerned. The electric percussion hammer confirmed previous diagnosis of internal crural and external cutaneous neuralgia. There was also a sensation of itching over a small area about 5 cm. below the right costal margin at the level of the tip of the eleventh rib.

January 8, 1930, blocking of the third lumbar nerve on the right side with 5 c.c. of a solution consisting of 95 per cent alcohol and 2 per cent neocaine in the proportion of 1 to 4. Immediately after the injection the patient felt a burning sensation on the inner surface of the right thigh. The second lumbar nerve was also blocked with 4 c.c. of the same solution. The pain subsided in the thigh and it was decided not to do anything for the itchy spot below the costal margin. In case this would persist it would be advisable to inject subcutaneously a few cubic centimeters of 1 per cent solution of pure neocaine. The next morning the patient complained of pins and needles in the leg and thigh. The following day everything had gone back to normal. February 10, 1930, examination of patient revealed absence of pain in the limb. There is no motor disturbance of any kind and no sensory cutaneous changes. She is able to perform her household duties without any difficulty. She sleeps well and has a good appetite but complains of some itching sensation as before. On February 12, 1930, subcutaneous injection of 20 c.c. of 1 per cent pure neocaine was made. This was followed by anesthesia and the itching sensation subsided.

CASE VII. T. H., female, sixty-five years of age, housewife, was first seen in February, 1929. She complained of severe pain in the back radiating downward toward the right thigh; duration three weeks. Past history revealed pneumonia fifteen years ago; passed through menopause about ten years ago, at which time she had hemoptysis. She was told by family physician that she had weak lungs and needed rest. She always suffered from rheumatism and is addicted to aspirin, taking as many as 4 tablets a day with physician's approval.

About three weeks ago, following an automobile trip the patient developed severe pain in the back over the kidney region, more marked on the right side, with radiations downward toward the hip and thigh, forward above Poupart's ligament toward the groin and downward toward the calf, ankle and big toe. The pain was continuous and very severe. The family physician was called and diagnosed sciatica. He prescribed various remedies among which were aspirin, atophan, codeine and veronal, but without success. Another physician was called in consultation and he advised injections which were made somewhere in the back and gave a slight numbness for a short time. The pain was so severe following the last injection that the family decided to call Dr. Greene who made a complete physical examination and diagnosed, by means of the electric percussion hammer, external cutaneous and anterior crural neuralgia with slight involvement of the sciatic nerve, with focus in genitourinary tract and sinuses as well as in the lungs. Pulmonary tuberculosis of advanced type with fibrous changes. *Radiographic examination* revealed a consolidation of the left upper lobe with displacement of the trachea to the left. Also diaphragmatic adhesion on the right side. Examination of the spine revealed moderate productive changes at the margins of the bodies of the lower dorsal and upper lumbar vertebrae, especially from the tenth dorsal to the second lumbar nerve, suggestive of a hypertrophic osteoarthritis.

March 3, 1930, blocking of the right first and second lumbar nerves was made with 95 per cent alcohol and 1 per cent neocaine in equal parts. Paresthesias were induced in the territory supplied by the second lumbar nerve. The first sacral nerve was then blocked with paresthesias along the posterior aspect of the leg, toward the foot, followed by sensation of pins and needles; 5 c.c. of the solution were

employed at each nerve. Testing of sensitive areas was postponed for the next twenty-four hours because of nervous chills which developed

of all narcotics. Fortunately she pulled through and on March 7, was quiet and bright although complaining of slight pain in the right leg.
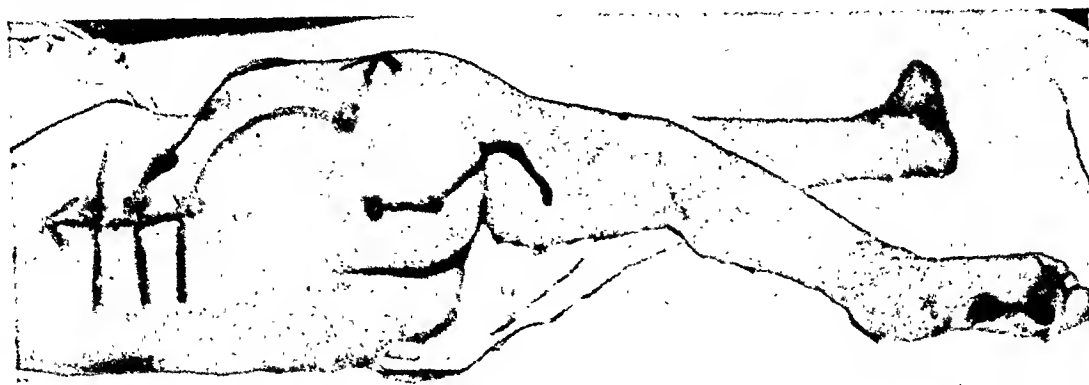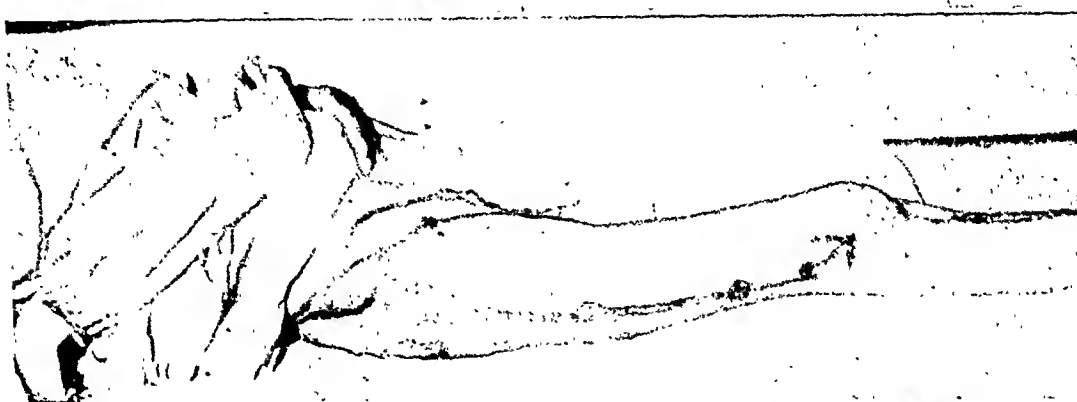

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 5 (Case vii). Tracing showing involvement of second and third lumbar and first sacral nerves on right side. The tracings in the lumbosacral region mark the second, third and fourth lumbar, while no tender spot is seen over first sacral nerve; but the tracing on buttock and posterior aspect of thigh and that on sole indicates first sacral involvement.

Fig. 6 (Case vii). Tracings on anterior and lateral aspects of groin and thigh of painful projections radiating from lumbar region. The second lumbar nerve is very well defined in this picture.

Fig. 7 (Case vii). Tracing on anterior and inner aspects of thigh and inner aspect of leg and ankle, revealing presence of diseased long saphenous nerve, branch of anterior crural.

immediately after the blocking. These chills gradually subsided within twenty minutes. Instructions were given to the nurse not to give any narcotics, to watch the pulse and respiration, to support the heart action and to administer sedatives in the form of bromides only if necessary. The convalescence was very stormy as a result of sudden complete cessation

March 27, the leg was retested with the electric percussion hammer which revealed the absence of the tender areas which existed along the first and second lumbar and first sacral nerves. Hyperesthesia replaced the original pain, the patient took short daily walks leaning slightly upon the arm of her nurse. This patient was bedridden and almost a ruin when we first saw

her. She is now out of bed and enjoys relatively good health.

CASE VIII. S. F., female, fifty-four years of age, was first seen on April 18, 1930. She was suffering from pain in the kidney region radiating downward toward the left leg and to the toe, forward along Poupart's ligament and in the inner surface of the thigh; duration two months. In her past history patient claims that she had an accident two years ago. She injured her spine following which she was bedridden for several weeks.

Following a cold one day the patient awoke with a stiff neck. The next day she had a pain in her leg which has since persisted. Weather has no influence on the condition. She saw three physicians who diagnosed her case as "dislocated hip," "sprained ligament," and "cold in the muscles." She was x-rayed. At the time of first consultation, she wore a brace and felt worse.

General physical examination led to the diagnosis of neuralgia of focal origin with focus in teeth, frontal sinuses and genitalia. *Radioscopic examination* of the dorsal and lumbar spines revealed moderate productive changes at the margins of the bodies of the vertebrae. There is a diastasis of sacrococcygeal articulation. An oval area is visible in the pelvis, in the region of the left ovary. No irregularity in the outline of the pelvis or hips. A denser, larger and more homogeneous oval area is noted at the posterior aspect of the left femur. The density is the same and can be compared with fluid or muscle. Involvement of left ethmoidal and maxillary sinuses. Periapical absorption of the left cuspid. Periodontitis of the left upper molar tooth. Periodontitis of the right upper cuspid.

April 30, 1930, blocking of L 1, L 2 and S 1 on the left side with 5 c.c. of a solution composed of 95 per cent alcohol and 1 per cent neocaine in the proportion of 1 to 2. Injection of L 1 and L 2 was followed by sensation of pins and needles and heat radiating along the external cutaneous nerve. Blocking of S 1 was associated with severe burning sensation over posterior aspect of thigh, middle of sole up to the toe. Testing with the electric percussion hammer revealed disappearance of all previous tender spots, except one which persisted on the inner surface of the thigh. Blocking of L 3 reserved and to be done, if necessary, after four weeks. On September 12, 1930, tenderness

persisting along the anterior and inner aspects of thigh. Blocking was made of L 3 and L 4 with 10 c.c. of solution composed of 95 per cent alcohol and 1 per cent neocaine in the proportion of 1 to 5. Weakness of the limb following the blocking caused the patient to stay in the hospital for twenty-four hours. She left the next day and since then is able to attend to her household duties without any discomfort.

CASE IX. M. G., female, fifty years of age, was first seen on March 19, 1930. She was suffering from sharp pain around the left kidney region radiating downward to the thigh, leg and ankle; duration two years. Past history revealed an operation performed in January, 1929, for alleged tumor of the spine, diagnosis which was not confirmed by operation. Prior to this operation, patient had been treated for sciatica by the application of a cast to "stretch the sciatic nerve." Patient apparently felt worse. Following her operation, she was given diathermy and electricity without result. When pain began, two years ago, patient noticed that upon bending or doing housework, she felt slight pain in the back along the spinal column. The condition grew progressively worse until she consulted a physician.

General physical examination led to the diagnosis of neuritis involving L 1, L 2, L 3 and S 1 on the left side, focal in origin with focus in teeth, sinuses and genitalia complicated by chronic cholecystitis, secondary anemia, narcotic drug addiction and neurasthenia. Vaginal smear was negative. *Radioscopic examination* of the vertebral column revealed slight productive changes at the margins of the dorsal vertebrae especially from D 6 to D 12; the arches of L 1, L 2 and L 3 are open (laminectomy with several spots of opaque matter in the spinal canal). There are productive changes between D 12 and L 1, where the maximum of opacity is present; the conclusion is arthritis deformans of the spine. There are slight productive changes at the margins of the sacroiliac synchondroses, more pronounced on the left side, also around the first sacral segment.

April 30, 1930, blocking of L 2, L 3 and S 1 and S 2 on the left side with a solution containing 95 per cent alcohol and 1 per cent neocaine solution in the proportion of 1 to 2, 6 c.c. being used at each nerve. Immediately upon blocking of L 2 patient felt sensation of heat radiating towards the hip joint, the sensation

of pain previously existing along Poupart's ligament was replaced by that of pins and needles. After the injection of L 3 the pain

CASE X. M. H., male, forty-two years of age, was first seen on April 1, 1930. He complained of pain around the right kidney region,
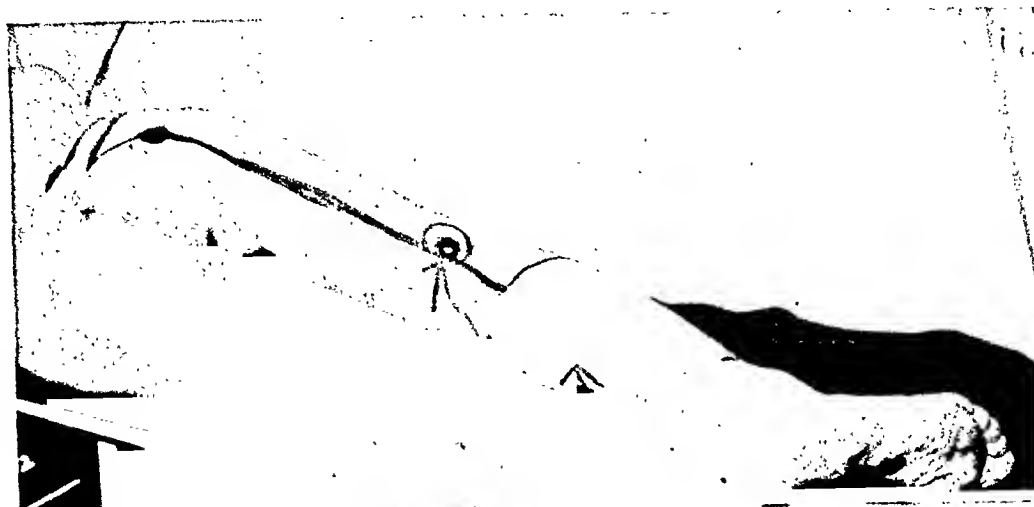

FIG. 8.

FIG. 9.

FIG. 10.

FIG. 8 (Case x). Tracing showing on posterior aspect of buttock and thigh, path of sciatic nerves. The dot on buttock marks exit of great sciatic nerve from the sacrosciatic foramen. The dot with the arrow just above bend of knee marks division of great sciatic nerve into internal and external popliteal nerves.

FIG. 9 (Case x). The tracing in this photograph indicates a long saphenous nerve involvement. Note tender spots on sole in both Figs. 8 and 9, denoting sacral involvement.

FIG. 10 (Case x). This tracing shows connections between L 2, L 3, and S 1, possibly S 2. The dot surrounded by a circle in the neighborhood of anterior superior iliac spine indicates zone of extreme tenderness which was referred to external cutaneous nerve, L 2.

in the anterior aspect of the thigh disappeared, the tenderness of the posterior aspect of the leg, sole and big toe still persisted. Blocking of S 1 and S 2 was followed by a sensation of intense burning radiating downward toward the foot. Patient's condition greatly improved.

extending downward to the thigh and leg, ending around the ankle, duration one year. Patient claims that he had had a similar attack ten years ago. Past history revealed chronic rheumatism and operation of right thumb for infection six years ago. Following an acute

eold, patient developed pain in the lumbar region ten years ago. Since that time he had several attaeks whieh grew in severity and duration, the last attack the fourth one during the past year and which is already of three weeks' duration, caused partial impairment of motion of his right lower limb; espeeially on bending the leg he experienced a cramp-like sensation in the ealf and ankle, radiating upward to the lateral surfaee of the hip, thence to the lumbar region; the pain was continuous and aehing, it did not yield to any electrie treatment, bath, massages and various medieations prescribed by physicians during the past ten years. He was told that he was suffering from sciatica; there seemed to be no relation between the pain and change of weather.

General physical examination led to a diagnosis of anterior crural and external cutaneous neuralgia, foeal in origin with focus in tonsils, sinuses and possibly in prostate; *radioscopic examination* revealed rudimentary frontal sinuses, decreased illumination of both ethmoids and maxillary sinuses. Saeralization of L 5 with slight dextroscoliosis at the lumbosacral angle. The artieular surfaces of L 4 are obliquely frontal. There are slight produetive ehanges at the margins of the bodies of the lumbar vertebrae.

April 9, 1930, bloeking of L 2, L 3 and s 1 with a solution of 95 per eent aleohol and 2 per cent neocaine in equal parts, 5 c.c. of the mixture being injected at eaeh nerve. Following the blocking a sensation of heat was felt in the entire limb which became very weak and caused difficulty in walking. Following a rest of two hours and a half in the recumbent position the patient walked out of the offiee saying that his leg was a little stiff but that the pain had subsided. Two days after the blocking the patient had another attaek; at least he complained of pain in the leg. He was advised to temporize until April 23 on which date bloeking of s 1 and s 2 was followed by excellent results. A slight disturbance which the patient deseribed as "catehing-like" pain in the middle of the right buttock still persisted; the condition however gradually improved until it subsided completely. The patient is now able to walk without any diffieulty and is free from pain.

Results. The results obtained are as follows: 8 patients were completely relieved of the condition for which they consulted physicians; out of these 1 still has some muscular pain on both sides of the buttocks. This may have no relation whatsoever with the original pain, but we are ready to accept that this was only a partial success. Of the 2 remaining cases subsequent blockings left what is described as a spasm of the muscles on the left side of the lumbar region, in 1 case, and a very mild pain described as cramp-like sensations during changes of weather in the other.

Comments. The diagnosis of the so-called sciatic neuralgias must not be confined to the use of the electric percussion hammer which is an instrument designed to determine with accuracy the tender spots in the territory complained of and, by comparison, to give an intelligent means of detecting the correct nerve and finding its path. A general physical examination is of the highest importance because it reveals pathological conditions associated with the neuralgia and permits of its eradication immediately after the nerve-blocking. It is imperative that the foci of infection be cleared while the treatment of nerve-blocking is being instituted. Radiographic examination is priceless, because of the notion which it gives of associated pathological conditions of the bony structures and is one more means of reaching accuracy in the diagnosis of the affected nerves. X-rays of the spine should always be made, as they may reveal productive osteoarthritis which may be responsible for certain types of neuralgia, amenable to nerve-blocking. Abnormal motility of articulations may also be revealed, a condition which comes within the territory of orthopedic surgery.

Conclusions. (1) The so-called sciatic neuralgias include not only painful conditions of the sciatic nerves (great and small) but not infrequently associated conditions of the external cutaneous and anterior crural nerves.

(2) Correct diagnosis of the nerves involved is of the highest clinical importance.

TABLE I. Graphic representation of periods of sensory manifestations before and after blocking. Comparison is here as a direct or indirect result of the use of alcohol, so

SYNOPSIS OF SENSORY CHANGES

Original Sensory Manifestations A.B.	Pain Persistency A.B.	Pain Distribution A.B.	Nerves Blocked	Immediate Sensory Manifestations P.B.
Case VIII. S. F. Continuous aching like a tooth.	Two months	In kidney left region, radiating downward toward the left leg down to the big toe and also extending around the left side of the groin down the leg.	First and second lumbar and first sacral nerves on left side.	Severe burning-like, intermittent with some pins and needles over the posterior aspect of thigh and middle of sole up to toe for 2 hours.
Case IX. M. G. Continuous twitching, stiff and aching like a tooth.	Two years	Around the left kidney region, radiating downward toward the leg and thigh and ankle. At outer and inner surface and at posterior aspect of leg toward the base of left big toe.	Second and third lumbar, first and second sacral nerves, on the left side.	Intense burning and pins and needles which disappeared a few hours after injection, also sensation of heat which persisted for two days.
Case V. I. H. Intermittent sharp, aching like a tooth.	Twelve years	In left lumbar region, radiating toward outer and inner surfaces of leg and also toward posterior aspect of thigh.	Second and third lumbar and first sacral nerves.	Burning and heat-like sensation for 3 days.
Case VI. G. H. Continuous aching and spasmodic.	Four years	Above right kidney, radiating toward the thigh (outer and inner surfaces) and inner aspect of leg to about 30 cm. below the knee.	Second and third lumbar nerves on the right side.	Burning sensation.
Case VII. T. H. Continuous twitching, sharp and aching like a tooth.	Six weeks	In back, over kidneys, more on right side, radiating downward to hip and thigh and forward above Poupart's ligament toward groin and downward toward the calf, ankle and toe.	First and second lumbar and first sacral nerves on the right side.	Sharp, burning sensation, nervous chills which subsided in 20 minutes.
Case X. M. H. Intermittent cramp-like.	Ten years	Around the right kidney, radiating downward to thigh and leg, ankle and big toe.	Second and third lumbar, and first sacral nerves. Second sacral nerve injected at second session. All on right side.	Difficulty in walking, stiffness and sensation of warmth for 2 days. Cramp-like twisting pain, intermittent with burning sensation, after second injection
Case II. R. J. Intermittent aching like a tooth.	One year	On left side of back, radiating downward toward outer surface of thigh.	Second lumbar, first and second sacral nerves, on the left side.	Severe heavy pressure and pins and needles disappearing a few hours after injection and lump-like feeling which lasted for 4 days.

established between the periods of suffering before blocking and those during which disturbances were experienced as to show the advantages derived from the treatment.

AFTER LUMBAR AND SACRAL BLOCK

Remote Sensory Manifestations P.B.			Numbness	Return of Pain	Received Treatment
Burning Like Fire	Pins and Needles	Other Manifestations			
Pins and needles disappeared after two hours and severe burning-like sensation persisted for 28 days.	On the twenty-ninth day, pins and needles appeared and persisted for 7 days.	No	On the thirty-seventh day, numbness appeared and the patient felt completely relieved of pain.	120 days after blocking pain in anterior crural nerve, suggested local reinjection. Muscles on left side of lumbar region are in spasm.	Yes
Burning sensation replaced that of heat on the third day, lasted for 21 days and was confined to lower aspect of toe, posterior aspect of calf and inner aspect of calf and leg.	On the twenty-fourth day, pins and needles appeared, continued for 28 days and was confined to buttock, leg groin and big toe.	No	On the eighty-fourth day, all previous sensations disappeared, replaced by numbness in entire leg.	No	Yes
Burning sensation became accentuated, lasted for 35 days and was confined to entire leg, except anterior surface.	Pins and needles appeared at the end of thirty-fifth day and lasted for 42 days. Intermittent, confined mostly to big toe, calf and groin.	No	On the seventy-seventh day numbness appeared.	Unknown, as patient did not return for further check-up.	No
Burning sensation, persisted for 28 days and was confined to outer and inner surface of thigh.	Pins and needles and cramp-like sensation, intermittent, lasting for 21 days.	No	On the fiftieth day, numbness appeared, confined to ankle and lateral surface of thigh.	No	Yes, daily.
Burning sensation persisted for 35 days and was confined to outer and inner surface of leg, toward the foot.	On the thirty-fifth day, pins and needles replaced the burning sensation and was confined to entire leg and persisted for 49 days.	No	On the eighty-fourth day, numbness appeared and all previous existing pain disappeared. Patient able to walk freely without any discomfort.	No, but has muscular pain on both sides of buttocks.	Yes
Burning-like sensation began at end of second day, persisted for 14 days and was confined to calf and lumbar region. Followed by another blocking. This time cramp-like twisting pain intermittent with burning sensation for 28 days confined to calf and buttock.	Pins and needles replaced previous sensations, persisted for 14 days and confined to posterior aspect of calf, thigh and buttock.	No	42 days following the second injection, numbness replaced all previous existing sensations and was confined to posterior aspect of calf, thigh and buttock.	No	Yes, intensive treatments consisting of water baths and massages.
Replaced by burning sensation on the fifth day and persisted for 90 days. On the sixtieth day this was aggravated by a twisting and cramp-like sensation and confined to left thigh.	Pins and needles replaced this previous sensation on the ninty-fifth day, was confined to the calf chiefly and persisted for 30 days.	No	On one hundred twenty-fifth day, the sensation of numbness established itself definitely and patient did not complain of any further pain.	No	No

SYNOPSIS OF SENSORY CHANGES AFTER

Original Sensory Manifestations A.B.	Pain Persistency A.B.	Pain Distribution A.B.	Nerves Blocked	Immediate Sensory Manifestations P.B.
Case III. P. R. Intermittent cramp-like and spasmodic.	Ten months	In right lumbar region, in calf and at big toe.	First sacral nerve, on the right side.	Sharp burning sensation with heat for 2 days.
Case IV. B. S. Continuous spasmodic and twitching.	Two weeks	In region of second lumbar on the right side, radiating toward the acetabulum and along side of Poupart's ligament, then descending downward on lateral side of right thigh about 10 cm. where thigh and abdomen meet. Again about 10 cm. above knee and more toward middle line. Pain disappears and reappears about 10 cm. above ankle joint.	Second lumbar nerve, on the right side.	Slight sensation of stinging pain which lasted for 1 day.
Case I. M. T. Continuous sharp twitching like.	One month	Above the right kidney region and radiating towards the inner surface of thigh, disappearing round the knee and reappearing on inner surface of ankle joint.	Third lumbar nerve on the right side. Second injection made at second lumbar nerve, on the right side.	Heat and lump-like sensations. Heat and lump-like sensations on lateral surface of thigh.

Note: A.B.—Ante-blocking. P.B.—Post-blocking.

(3) The electric percussion hammer is of valuable help both in diagnosis and treatment.

(4) Individual blocking of these nerves is here recommended in lieu of the classical caudal or epidural block which may be followed by impairment of the vesical and anal sphincters, as well as by weakness of both lower extremities, to say the least.

(5) Individual block improves the circulation on the affected side and gives greater comfort to the patient.

(6) The use of pure alcohol is contraindicated, because of permanent damage that may ensue to motor function.

(7) Mixtures of alcohol and neocaine in weak solutions and concentrations give better results.

(8) The reaction or distortion of perception of sensations following alcohol block is occasionally severe and of rather long duration, but individual psychology is a great factor in their maintenance.

(9) Physiotherapy in the form of diathermy, infra-red rays and massage seems to be accepted differently by different individuals. As a general rule, diathermy does not give as satisfactory results as infra-red rays and massage. Some patients do well by being left alone after explanation of the different phases of the sensory changes they are likely to go through. Others derive a real benefit from the post-blocking treatment.

(10) Many patients were becoming or had become drug addicts. Nerve blocking has been a substitute for the narcotic drugs.

(11) Painful conditions associated with productive osteoarthritis can be relieved by the use of alcohol-neocaine nerve block.

LUMBAR AND SACRAL BLOCK (*Continued*)

Remote Sensory Manifestations P.B.			Numbness	Return of Pain	Received Treatment
Burning Like Fire	Pins and Needles	Other Manifestations			
Burning sensation became accentuated and persisted for 21 days and confined to back, posterior aspect of thigh and toe.	Pins and needles replaced previous sensation and this was intermittent with a cramp-like sensation which persisted for 14 days and was confined to toe and calf.	Cramp-like feeling.	On the forty-third day numbness appeared on the buttock and at big toe.	Cramp-like sensation returned once in a while. Return of pain very mild during change of weather.	Treatments received irregularly.
Burning sensation intermittent with stinging pain for 28 days and distributed over Poupart's ligament and lateral surface of leg.	On thirtieth day, pins and needles and sensation of weight developed in lumbar region about 10 cm. above the knee, lasting for 14 days.	No	On forty-fifth day the sensation of numbness replaced all previous sensations and lasted for 120 days.	No	Yes
Pins and needles replaced by burning sensation in abdomen and numbness in leg on sixth day, persisting for 28 days. Patient reinjected 5 weeks after first injection.	Heat and lump-like sensation replaced by pins and needles and confined to outer side of thigh for 5 days.	On the third day following the second blocking, patient experienced a cramp-like twisting sensation which persisted for 21 days. This was associated with spasm of psoas muscle.	Numbness was definitely established on the lateral surface of thigh on the twenty-eighth day following the second blocking.	No	Yes, intensive.

(12) It is not possible to foretell the period of relief, because this method of treatment is comparatively new and delicate in its application; but in our experience it has given encouraging results and promises to be the method of the future.
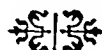
STUDIES IN SPINAL ANESTHESIA*

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THE advance of any new or modified procedure in medicine is heralded by an attitude of criticism. This criticism may resolve itself into a destructive force that puts to naught any or all claims made for the procedure. It may be a healthy constructive force that brings to light any advantages that it may have. Destructive or constructive criticism is often tinged with prejudice. "Prejudices," as Bishop Berkeley once said, "are notions or opinions which the mind entertains without knowing the grounds or reasons for them, and which are assented to without examination."

Prejudices against certain manifestations of spinal anesthesia still persist, and have been the basis of modifications in the technique hitherto used. The most recent modifications advanced are the use of controllable solutions and vasoconstricting drugs.

It is the purpose of this paper:

1. To consider the bases upon which these changes have been recommended.

2. To consider the pharmacological and physiological effects of the agents involved.

3. To relate results obtained by the use of these procedures.

4. To report on the blood chemistry investigation in patients operated upon under spinal anesthesia and compare with as nearly parallel a series of patients operated upon under the gas-ether sequence as was possible to obtain.

Throughout the period of growth of spinal anesthesia and to the present day, the two greatest arguments against this form of anesthesia have been:

1. The fall in blood pressure.

2. The danger of respiratory paralysis.

FALL IN BLOOD PRESSURE

As to the fall in blood pressure, there are those who feel that a fall in blood pressure, no matter to what extent, can result in no serious consequence, if cerebral anemia is prevented by an adequate Trendelenburg position. Hill[28] feels that the fall in blood pressure which occurs in spinal anesthesia, should be regarded as an indication of the amount of vasodilation and the need for the Trendelenburg position; but not as a sign that the situation has developed into one of unexpected gravity. Others feel that a fall in blood pressure to any great extent is a sign of severe circulatory or vascular depression, leading or conductive to true shock. Sise[32] feels that vascular depression is the most serious condition which accompanies spinal anesthesia and is the cause of most of its mortality. Those that believe that the fall in blood pressure is a serious matter prevent or treat it. They feel this way in spite of the fact that no one has definitely proved that the clinical pictures of spinal anesthesia and surgical shock are exactly the same.

The etiology of the fall in blood pressure has been so often repeated in papers of this kind that it will suffice if I mention it in brief. Labat[27] has best described it. The fall is caused by pooling of blood in the splanchnic vessels as result of paralysis of vasoconstricting fibers coming from the sympathetic ganglia, caused by the action of the drug on the anterior roots.

Let us consider the shock producing reputation[14] of spinal anesthesia. Surgical shock, as defined by Cannon,[25] is a general bodily state characterized by persistently reduced arterial pressure; by a rapid thready pulse; by pallid, greyish or slightly cyanotic skin which is cold and moist with sweat and by a superficial rapid respiration. McKesson has laid down rules for shock determination. He holds that a typical case of shock is characterized by a diastolic pressure of 80 mm. or less, a pulse pressure

of 20 mm. or less and a pulse rate of 120 or more. He also states that after a half hour of sustained low pressure and rapid pulse the patient succumbs either shortly or within three days of surgical shock or heart exhaustion.

These are the cardinal signs of surgical shock. A patient to be in surgical shock must exhibit all of these signs. Now, how does the circulatory picture in spinal anesthesia differ? True, the patient under spinal anesthesia exhibits a picture pretty close to the one described. The diastolic pressure is apt to be 80 mm. or less, the pulse pressure 20 mm. or less but the pulse rate is almost never 120 or more. The only time that the pulse rate is 120 or more is when the patient comes to operation suffering from prostration, shock, or hemorrhage. Even then, the pulse rate is more apt to come down than go up under spinal anesthesia. Is the difference in the pulse rate picture in spinal anesthesia and that in surgical shock important enough to consider? I believe that it is important enough to say that it changes the entire picture. Why?

In surgical shock, the patient is suffering from a blood pressure that is low and falling, a pulse rate that is rapid and climbing. The patient's circulatory system is thrown into a vicious cycle. The lower the blood pressure falls, the higher rises the pulse rate. Associated with this condition is the excessive perspiration almost always present in surgical shock which aids the fall in pressure. *The circulatory system is in a state of exhaustion.* Whereas, under spinal anesthesia the blood pressure is low and falls, soon to reach its lower level where it stays. *The pulse rate remains in its proper relationship to the systolic and diastolic pressures.* The lower the blood pressure, the lower falls the pulse rate. There is no concomitant loss of body fluids by perspiration as in surgical shock. Respirations are slow. *There exists a state of circulatory relaxation.* Furthermore, the patient under spinal anesthesia returns to bed with a rising blood pressure. The patient in

surgical shock returns to bed with a blood pressure that is low or falling. In short the blood pressure-pulse rate ratio in spinal anesthesia is not altered, whereas in surgical shock this relationship is definitely disturbed.

The low pulse rate in spinal anesthesia is the saving factor. Cannon believes that, in surgical shock, the patient dies because the pulse rate becomes so rapid and the period of diastole so short, that in the presence of a low blood pressure the heart cannot take up within its walls sufficient nutrition to carry on. Under spinal anesthesia the blood pressure may be as low as that in surgical shock, but the period of diastole is greatly lengthened giving the heart sufficient time to nourish itself, even in the presence of a low blood pressure. It is my opinion, therefore, that it is more important to maintain a low pulse rate than a normal blood pressure.

The patient under spinal anesthesia is not suffering from surgical shock or a condition to be likened to it. Moreover, I feel that spinal anesthesia acts as a prophylactic measure to surgical shock for two reasons:

1. It pulls the pulse rate down, thus preventing inception of a vicious cycle.

2. Spinal anesthesia by its nerve block prevents the piling up of incoming stimuli.

Burch and Harrison,[22] in studying the effect of spinal anesthesia on cardiac output conclude that the initial change is in arterial pressure and the venous return and cardiac output are affected secondarily. This sequence of events is just opposite to that in hemorrhage. Blalock[23] has shown that in hemorrhage the cardiac output decreases first and is already reduced from one-third to one-half before a significant decline in mean arterial pressure occurs.

Those that feel that the fall in blood pressure should be prevented or treated have done so by using one or a combination of the following procedures:

1. The use of controllable agents.

2. The use of vasoconstricting drugs as adrenalin, strychnine, and ephedrine.

3. The administration of fluids intravenously.

CONTROLLABLE AGENTS

Theoretically, the higher the anesthesia, the greater the number of anterior roots involved and the greater should be the fall in blood pressure. Therefore, there is the attempt to limit the number of anterior roots involved to those absolutely necessary to the area of operation, by using drugs of a specific gravity different from that of spinal fluid, a heavy and a light solution.

Heavy Solutions. The solution of heavy specific gravity most commonly used is one of a solution of novocaine in glucose. Thus, in trying to limit the upward extent of novocaine when using this solution, it is necessary to place the patient in a modified Fowler's position, i.e., with the head higher than the pelvis. This technique has been almost entirely discarded since it is realized that the Trendelenburg position is the safest and most dependable way to prevent cerebral aenmia.

Light Solutions. The most popular solution of lighter specific gravity is one containing novocaine as the anesthetic agent; starch to increase its viscosity; alcohol to lower its specific gravity, and strychnine to stimulate the sympathetic nerves. The theory behind this is that by the introduction of this viscid solution within the subarachnoid space, its diffusion will be diminished and its period of absorption lengthened, so that by lowering the head of the table one can limit the upward extent of the drug.

The use of this agent in my hands and the hands of others,[5,20,28] has not lived up to its reputation of being absolutely controllable. It is impossible to determine beforehand to exactly what level the anesthesia will extend. Careful investigation will disclose a level of anesthesia either lower or higher than that anticipated. Donald[6] asks, "Does controllability matter?" He concludes as does Hill,[28] that the use of this viscid solution of lighter specific gravity than spinal fluid is no more controllable than novocaine or neocaine crystals dissolved in spinal fluid and used as the anesthetic agent.

Sise,[10] in reviewing statistics reports 11 deaths due to spinal anesthesia in the city of Boston in a current year. Of the 5 cases he details, all were patients to whom a controllable anesthetic had been administered. Four of the agents were of the viscid nondiffusing type and the fifth one of the novocaine in glucose type.

Stout,[12] using a solution of novocaine in spinal fluid has advanced a volume control technique. He feels that the height of anesthesia is proportional to the dosage, the amount of solvent, and the time taken to inject the solution. I feel that the height of anesthesia is more proportional to the amount of solvent than any other single factor.

VASOCONSTRICTING DRUGS

A. *Adrenalin.* Evans[13] recommends epinephrine highly and feels that it is of greater value than ephedrine. Sise[32] advises the use of adrenalin as a vascular supportive after the induction of anesthesia. The action of adrenalin and ephedrine is alike except that adrenalin acts sooner but is not as prolonged.

B. *Strychnine.* Pitkin[31] recommends the use of strychnine because of its action on the vasoconstrictors. As to the value of strychnine Hill[28] feels it is contraindicated and says that it produces a state opposite to that desired, that is, strychnine breaks down the internal resistance of the spinal cord so that a definite stimulus produces a greater motor response than under normal conditions. This, in spinal anesthesia, leads to the early onset of rigidity and puts the patient into a state diametrically opposed to that desired by the anesthetist, who wants a smaller response to a given stimulus. He wants the passage from one side of the reflex arc to the other made more difficult, and the internal resistance of the cord increased.

Sollmann[29] says, "The effect of therapeutic doses of strychnine on the blood

pressure are so inconstant and small that they can be accidental."

Jonnesco[30] has given up the use of strychnine after fifteen years' trial.

c. *Ephedrine.* The literature on the use of ephedrine in spinal anesthesia abounds with praises as to the benefits to be derived from the use of this drug. This drug has been and is still being used without the knowledge of its other effects or associated dangers.

Ephedrine, the alkaloidal active principle of ma huang was first isolated in 1885. In 1923 Chen[7] re-isolated it. He[6] claims that the rise in blood pressure which it causes is due to simultaneous vasoconstriction and cardiac stimulation produced by stimulation of the corresponding sympathetic fibres. *Cardiac stimulation, he feels, plays a larger share than vasoconstriction* in the pressor effect of ephedrine in anesthetized animals. He states that ephedrine in small doses might cause cardiac failure when administered after a period of low blood pressure. Bloedorn and Dickens[9] state that coincident with the rise in blood pressure is an acceleration in pulse rate. They feel that this drug is contraindicated in cases of cardiac insufficiency and that the use of ephedrine may result in arrhythmia. Sise[10] feels that large doses of ephedrine put a heavy load on the heart and may cause cardiac failure. He cites 2 deaths due to overdosage. Blalock believes ephedrine injurious in severe shock. Rudolph and Graham[11] state that ephedrine should not be repeated as it will result in a harmful effect on cardiac muscle. They believe that it is apt to give rise to numerous extrasystoles and occasionally may result in acute cardiac dilatation. Phelps[19] believes ephedrine stimulates by its accelerator mechanism and that large doses depress cardiac muscle and cause fall in blood pressure. Electrocardiographic studies of the effect of ephedrine in man by Middleton and Chen[21] in 11 patients, the drug taken by mouth, 7 showed no change and 4 developed ventricular extrasystoles. These changes were more marked

in a patient with chronic myocarditis in whom the systolic pressure fell 30 mm.

Investigation into action of ephedrine on the splanchnic blood vessels of the dog was carried out by the author through the courtesy of the Department of Biology at Brown University. Ephedrine was administered to etherized dogs and its action on the mesenteric vessels noted. The action of spinal anesthesia on these vessels was also investigated. The conclusions drawn as the result of this study are that ephedrine increased the noticeable pulsations in the vessels but that there was no vasoconstriction. Spinal anesthesia administered to the dog after the injection of ephedrine caused vasodilation. Administration of ephedrine to a dog under spinal anesthesia causes no vasoconstriction.

So, to summarize, we have in ephedrine a powerful drug which, through its vasoconstricting action and by its cardiac stimulation, is capable of raising the blood pressure. It is an agent which is contraindicated in cases of cardiac insufficiency. In a small percentage of cases, it may cause ventricular extrasystoles and in cases of chronic myocarditis, its use is apt to cause a fall in blood pressure rather than a rise. It should not be given, even in small doses, in the presence of a low blood pressure. In large doses, it puts too heavy a load on the heart. It is of no value in severe shock. Its dosage must not be repeated.

What part does it play in spinal anesthesia? Does it maintain the blood pressure as has been claimed? Is its action characterized by an increase in pulse rate? If it does these, is it of value?

Action of Ephedrine on Blood Pressure. In a series of 120 spinal anesthesias on all types of patients and in all types of abdominal and lower extremity operations, preceded by administration of gm. .05 ephedrine subcutaneously, there was an average fall of 38 mm. Hg in the systolic pressure as compared with the preoperative pressure. In a like number of unselected cases of patients operated upon under spinal anesthesia and not preceded by

ephedrine medication and using neocaine dissolved in spinal fluid as the agent, there was an average fall of 60 mm. Hg in the systolic pressure.

As to the fall in blood pressure occurring during operation at different levels of the body both in using and omitting ephedrine:

	Lower Extremity Perineum	Lower Abdomen	Upper Abdomen	Average Fall
Ephedrine........	42 mm.	30 mm.	53 mm.	38 mm.
No Ephedrine....	53 mm.	53 mm.	75 mm.	60 mm.

This proves that ephedrine does not maintain the blood pressure at or near the preoperative pressure. It proves, however, that the administration of ephedrine does not allow the pressure to fall to the extent that would occur if it were not used. Both Donald[5] and Hill[28] reach the conclusion after a study of ephedrine that it does not prevent a fall in blood pressure

Action of Ephedrine on the Pulse Rate. In the cases in which ephedrine was used, there was a rise in the pulse rate over the systolic pressure in 44 per cent of the cases. In a like number of anesthesias and not employing ephedrine, there was an increase in the pulse rate over the systolic pressure in 20 per cent of the cases. I have tried to show earlier in this paper that a fall in blood pressure can result in no damage in the presence of the Trendelenburg position. I have also tried to show that as long as the pulse rate remained in its normal relationship to the systolic and diastolic pressures, the circulation was in a state of relaxation, and that if the pulse rate began to climb above the systolic pressure, thus destroying the normal blood pressure-pulse rate relationship, the circulation was passing through a period of stress or excitation. If the pulse rate climbed still higher, the circulation was in a state of exhaustion. This blood pressure-pulse rate relationship is important. Of 27 deaths in this series, 17 or 63 per cent ran a pulse rate during the operation higher than the systolic pressure. Of all cases where the blood pressure-pulse rate relationship was so disturbed, death occurred in 25.3 per cent of cases. In the cases where this relationship was not disturbed, death occurred in 5.3 per cent of cases. This, incidentally, may be used in prognosis. The patient running a pulse rate higher than the systolic pressure during the operation is not as apt to get well as one whose blood pressure-pulse rate relationship has remained normal.

What conclusions should be drawn about a drug that is dangerous to use in cardiacs, that should not be repeated, that could only be used in minimum doses, that should not be used in the presence of a low blood pressure and in spinal anesthesia, that has a marked tendency to disturb the normal blood pressure-pulse rate relationship, placing the patient in a condition closer to circulatory exhaustion?

I feel that its use is based on an unfounded prejudice and that it does not merit the place it has occupied in the hands of those employing it in spinal anesthesia. I feel also that its use is not only valueless but dangerous and that no vasoconstricting drug will ever find a place in spinal anesthesia unless it has a specific stimulating effect on the sympathetic fibers to the splanchnic blood vessels and has no action on any other part of the circulatory mechanism.

INTRAVENOUS INFUSION

The intravenous infusion of large amounts of solution, during operation or as a postoperative measure, is given with the belief and hope that a rise in blood pressure will result. The desire is to replace in the peripheral circulation, fluid that has been pooled in the splanchnic vessels. I feel this procedure may be safe on a patient who has had some other form of anesthesia, but in spinal anesthesia, this procedure is unwise. There is no point in trying to raise the blood pressure. The blood pressure will return as soon as the novocaine action on the motor roots wear off and not before. There is no fluid lost to replace. The patient has not been perspiring and losing large amounts of fluid as under ether anesthesia or in surgical shock. The addi-

tion of large amounts of fluids to a circulation where none has been lost may easily overburden that circulation. Furthermore, where will this fluid go to? Labat[12] has shown that under spinal anesthesia, there exist two centers of vascular tension, one high and one low. Fluid administered to a patient under spinal anesthesia will but be carried to the one of low tension and will but serve to increase the amount of splanchnic dilation.

I make but few exceptions to this rule of not administering fluid intravenously to patients under spinal anesthesia. The exceptions may be in the case of a patient who has lost a large amount of fluid previous to anesthesia. Thus, if a patient comes to operation in prostration or shock and perspiring greatly or in the case of hemorrhage, I try to replace only as much fluid as I believe the patient has lost. Another exception would, of course, be in the diabetic necessitating intravenous glucose medication.

RESPIRATORY PARALYSIS

The cry that a great danger of spinal anesthesia is respiratory paralysis is an old one. The action of novocaine on the respiratory center was the thing most feared. As late as February, 1929, Hilarowicz and Szajna[3] recommended KCl to be used with the anesthetic solution, giving as one of the advantages that it acts as an antidote to respiratory paralysis. It will suffice to say that the work of Koster[4] has shown that respiratory paralysis is not to be feared.

BLOOD CHEMISTRY STUDIES

One of the most important qualities an anesthetic agent must possess to make itself valuable in surgical procedures is an ability to leave undisturbed or to upset as little as possible the body metabolism. Any marked changes in the body metabolism should surely manifest itself in the blood chemistry. The extent of this change should be in direct proportion to the amount of change in the blood chemistry.

With this in mind, an attempt was made to determine the changes in blood urea,

blood sugar, and carbon dioxide combining power in patients operated upon under spinal anesthesia and compared with a like series of patients operated upon under gas-ether.

The patient's blood was taken early in the morning. Blood for sugar determination was collected in an oxalate tube. Blood for carbon dioxide determination was allowed to run from the needle through a capillary tube and collected under oil. Operations were usually performed in the morning. A second specimen of blood was taken about 4:00 P.M. A third specimen was taken the following morning at about 10:00 A.M. This gave three sets of readings, a preoperative reading, one four to six hours later, and the third about twenty-six hours later.

The methods of determination were for blood urea, method of Van Slyke and Cullen, modification of Marshall; for blood sugar, method of Folin and Wu; for carbon dioxide combining power, Van Slyke method.

Findings. In a series of 50 patients under spinal and a like number under ether, the following determinations were received:

	Urea	Blood Sugar	CO$_2$ Combining Power
Gas ether 6 hours	+ 4.27 mg./100 c.c.	+27 mg./100 c.c.	−10 c.c./100 c.c.
24 hours	+10.45	+18	− 3
Spinal 6 hours	+ 0.00	+ 5.4	− 7.8
24 hours	+ 3.72	+ 5.0	− 3

Blood Urea. Under ether anesthesia, there was an increase of 4.27 mg. per 100 c.c. at the end of six hours. At the end of twenty-four hours, this continued to increase to 10.24 mg. per 100 c.c. Using 15 mg. as the upper normal limit, there was an increase of 28 per cent at the end of the first period and 69 per cent at the end of twenty-four hours. Under spinal anesthesia, there was no increase at the

end of six hours and an increase of 3.72 mg. per 100 c.c. at the end of twenty-four hours. An increase in blood urea[16] is refer-
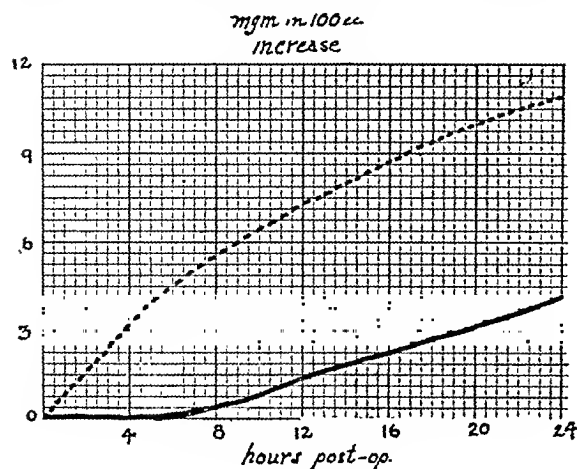
FIG. 1. Blood urea.
Spinal anesthesia————
Ether anesthesia————

able to accumulation due to defective elimination through the kidneys. It seems quite obvious, therefore, that spinal anesthesia would be indicated in cases where kidney damage is present or to be feared.
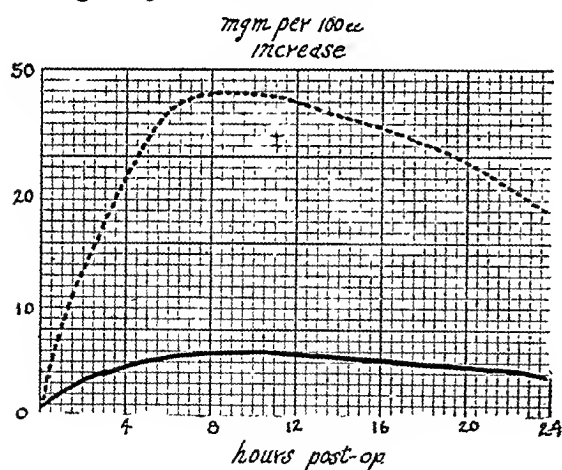
FIG. 2. Blood sugar.
Spinal anesthesia————
Ether anesthesia————

Blood Sugar. Blood sugar determination in the ether series showed an increase of 27 mg. per 100 c.c. at the end of six hours. At the end of twenty-four hours, this had dropped to 18 mg. per 100 c.c. Using 100 mg. as the normal, this was an increase of 27 per cent at the end of six hours and an increase of 18 per cent at the end of twenty-

four hours. For the spinal cases, the increase at the end of six hours was 5.4 per cent and at the end of twenty-four
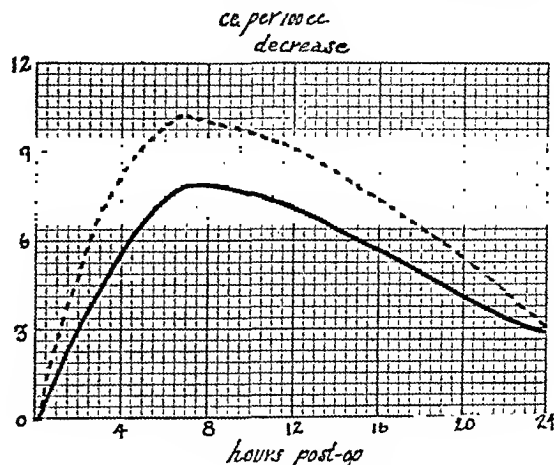
FIG. 3. CO_2 combining power.
Spinal anesthesia————
Ether anesthesia————

was 5 per cent. The hyperglycemia associated with anesthesia has been variously interpreted as either the result of diminution in sugar metabolism or due to an increase in glycogenolysis, that is, an increase in the rate at which glycogen in the liver is converted into sugar and given off to the blood. Estes and Burge[17] conclude that it is due to a decrease in sugar metabolism. Whatever this hyperglycemia is due to, there is no doubt that spinal anesthesia is advantageous in cases where an upset in the carbohydrate metabolism is to be feared.

Carbon Dioxide Combining Power. At the end of the six-hour interval, in the ether series, there was a decrease of 10 c.c. in each 100 c.c. of blood plasma. At the end of the twenty-four hour period, this had dropped to 3 c.c. Using 62 as normal, the six-hour period showed a drop of 16 per cent and the twenty-four hour period, 4 per cent. The spinal cases showed at the end of six hours a fall of 7.8 c.c. or 12 per cent and the twenty-four hour period, 3 c.c. or 4 per cent.

The ability of the blood plasma to bind carbon dioxide offers what is probably the most reliable means of detecting acidosis, and of measuring its degree.[16] Though the difference between the determinations in

carbon dioxide combining power in the ether and the spinal series is not as great as in blood urea and blood sugar, I feel safe in saying that the tendency to acidosis as shown by this is greater in the ether series than in the cases operated upon under spinal anesthesia.

The cases upon which these studies are made are as varied as could be obtained and a list of them is appended.

In a discussion of a series of cases under any anesthesia, it is but fair to consider the deaths that occurred. I shall not go into detail except to say that by far the largest percentage of deaths occurred in the cases of intestinal obstruction. In these cases, I have set myself a set of rules to guide me in the type of anesthesia to employ. In the acute intestinal obstruction with distention due to neoplasm, where the surgeon desires to do nothing but relieve the toxemia by intestinal drainage, it is wise to use field block. In the obstruction due to adhesions and where relaxation is necessary, spinal anesthesia is indicated. In the obstruction that is early and unassociated with marked distention and vomiting, it is safe to use spinal anesthesia to remove the obstructing mechanism. In short, if relief of symptoms is desired, use field block. If cure of the pathological process is the aim, use spinal.

There occurred in this series two deaths that may be said to have been unexpected. In the first case, the surgeon feels that the anesthesia was not responsible for the death, but the family physician has no doubt but that it was. In the second case, the surgeon, although admitting that the patient was an extremely poor risk and if she had had ether would have died within twenty-four hours, feels that spinal anesthesia was the cause of death on the operating table.

CASE I. Miss G. S., aged fifty. Preoperative, temperature 98.6, pulse 104, respiration 20, blood pressure 140/70. Heart and lungs normal. No history of palpitation, dyspnea, or edema. Preoperative diagnosis, acute intestinal obstruction. Anesthesia, neocaine gm. 150 c.c. at 4:35 P.M. Patient placed into Trendelenburg

position immediately after anesthesia. Fifteen minutes after induction of anesthesia B.P. 65/35, thirty minutes B.P. 55/30, pulse 100. This continued to end of operation. Operation, freeing of adhesions. Patient left operating room in seemingly good condition. Color good, patient conscious and rational. At 6:00 P.M., pulse 108, good quality, R. 32. At 7:15 P.M. pulse good, color slightly cyanotic. At 9:00 P.M., T. 100, P. 140, R. 36, seen by surgeon who felt that patient's condition was good. At 1:00 A.M., T. 104.4, P. 140, R. 18. At 2:45 A.M., intravenous saline by interne, B.P. 75/32, color slightly improved, but respirations slow. At 3:25 A.M., T. 106.8, and at 5:00 A.M., T. 108. At 6:15 A.M., patient died.

CASE II. Mrs. A. A., aged seventy-one. Preoperative diagnosis, large fibroid uterus. Patient had had two severe uterine hemorrhages previous to operation. T. 98.6, P. 100, R. 20, B.P. 160/80. Physical examination, Lungs clear. Heart action regular, sounds distant. No murmurs heard. Renal function, 11 per cent in two hours. Urine examination negative for albumin and sugar. R.B.C. 2,336,000; blood urea 18.17; Non-protein nitrogen, 31.3. Spinal anesthesia is induced by the use of gm. 120 neocaine preceded by gm. 05 ephedrine. Patient placed in Trendelenburg position. B.P. fell to 120/60 in ten minutes and in twenty minutes was 100/50. Large uterine fibroid removed and during abdominal closure, patient's pulse and blood pressure became imperceptible and respirations ceased. Cardiac stimulants and artificial respiration with carbon dioxide and oxygen did not revive the patient.

In conclusion, a fall in blood pressure per se, can result in no serious consequence if the patient is kept in the Trendelenburg position. The low pulse rate in spinal anesthesia is the saving factor. The circulation in a patient under spinal anesthesia is in a state of relaxation, as long as the blood pressure-pulse rate relationship is maintained. Controllable agents are of no advantage. Ephedrine, in safe doses, does not maintain the blood pressure at or near its normal level. Ephedrine by its cardiac acceleration places the patient in a condition closer to circulatory exhaustion. The blood pressure-pulse rate ratio in spinal anesthesia preceded by ephedrine is mid-

way between that of surgical shock and that of spinal anesthesia without the use of ephedrine. Intravenous infusion, unless indicated by loss of fluid out of the circulatory system, is of no value and may result injuriously. Blood chemistry studies show that a patient under spinal anesthesia has less protein retention, a better carbohydrate metabolism, and a lesser tendency to acidosis than under gas-ether anesthesia.

OPERATIONS UNDER SPINAL ANESTHESIA

Appendectomy, clean.............. 35
Appendectomy, with peritonitis...... 10
Bladder, cystotomy............... 9
Cystoscopy...................... 3
Fistula in ano................... 3
Gall bladder acute gangrenous....... 6
Cholecystectomy................. 45
Hemorrhoid..................... 10
Herniae, femoral..............'.... 4
Herniae, femoral strangulated....... 5
Herniae, inguinal.... 35
Herniae, inguinal strangulated....... 10
Herniae, umbilical................ 3
Herniae, umbilical strangulated..... 1
Hydrocele...................... 6
Hysterectomy................... 30
Interposition.................... 8
Intestinal obstruction acute........ 15
Intestinal obstruction chronic....... 3
Intestinal resection............... 3
Leg amputated.................. 5
Leg fracture.................... 1
Leg osteomyelitis................ 3
Enterostomy.................... 3
Perforated duodenal ulcer.......... 4
Perineal repair.................. 16
Pneumonic peritonitis............. 1
Prostatectomy perineal............ 3
Prostatectomy suprapubic.......... 35
Reclosure of Abd. Wd............ 1
Salpingo-oophorectomy............ 15
Gastroenterostomy............... 5
Uterine suspension............... 5
Hypernephroma................. 1
Nephrectomy.................... 8
Nephrotomy.................... 5
Carcinomatosis.................. 4

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DEATHS FROM SPINAL ANESTHESIA*

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THE use of spinal anesthesia for major surgery for the past five years has become so general that there is hardly a hospital of any size or importance throughout the country in which it is not practiced. Novocaine, neocaine, stovain, cocaine, nupercain are among the various drugs now being used for the purpose.

The more universal the application of a method of anesthesia becomes the more apt it is to be placed in the hands of individuals whose knowledge of its physiology and application is inadequate and who following the time old adage "Rush in where angels fear to tread."

L. F. Sise in 1929 attempted to collect the reports of deaths from spinal anesthesia in greater Boston for one year. He states that "A rough estimate of the number of spinal anesthesias given during this period (fourteen deaths) forces the conclusion that the death rate has not been better than one to one hundred." Against this we have the reports collected by Rygh and Bessesiu who have collected statistics of 250,895 spinal anesthesias with 75 deaths making a mortality rate of 1 to 3345. Using the deaths of which they have a brief clinical summary they were able to arrive at a corrected mortality rate, e.g., deaths due only to spinal anesthesia of 1 to 11,060. These are the estimates for the particular clinic from which they come but are they true for all hospitals? I am sure that the number of deaths from spinal anesthesia not reported exceed by far the number that are reported.

Whenever a process becomes so universal, attempts are made to adopt a uniform technique that is as foolproof as possible. With this idea in mind we adopted at the Harlem Hospital during the past year a definite routine on all spinal anesthesia cases.

All our spinal anesthesia patients re-ceived ¼ grain of morphine and ¹⁄₁₅₀ grain of atropine one hour before the time scheduled for the operation. Just previous to the instillation of the spinal anesthetic into the canal the patient received one ampoule of ephedrine (0.5 gm.). In the beginning of this series we injected all of our patients in the sitting posture but as we found the current literature containing more and more reports against the use of the sitting posture for the injection we reverted to the lateral prone position giving the injection with the patient lying on the side with the knees and head flexed. The injection was usually made in the region of the second or first lumbar space. About 5 c.c. of spinal fluid were withdrawn to dissolve 200 mg. of novocaine. This solution was drawn into a syringe and attached to the spinal needle; an additional 5 c.c. of spinal fluid was withdrawn into the syringe; then by a process of barbotage, injecting 3 c.c. and withdrawing 2 the entire fluid was injected into the spinal canal.

With this as our basic technique all our adult patients received the same dose. Practically all of our anesthesias were given by the same man. For a period of about nine months during which time 260 anesthesias were given we had no mishaps of any kind. A change of service occurred at this time. The same anesthetist remained on with the new operating team. Spinal anesthesia was continued as the routine anesthetic using the same technique. Within a period of less than three months during which time an additional 154 anesthesias were given there were 3 fatalities from spinal anesthesia. These all occurred on the table before the operation was begun. These were definitely and without a question of doubt caused by the anesthetic. These patients were apparently all in good physical condition and had been

in the hospital from five days to two weeks before operation; they were all considered good surgical risks. Two of these cases were gynecological, the third was a secondary operation on an old empyema. They all received 200 mg. of novocaine in 10 c.c. of spinal fluid reinjected by barbotage at about the level of the second lumbar space in the lateral prone position. They were all immediately placed in the Trendelburg position and all complained at first of an inability to breathe and speak. Apparently these patients all died of a respiratory failure; they were unable to breathe, they could not inhale. The pulse was obtainable at the wrist and over the heart for fully fifteen minutes after respiration had apparently ceased. During this time the patients made repeated efforts to breathe but were unable to do so. Whether this was due to a failure of the respiratory center or to a failure of the respiratory muscles one cannot definitely say. The impression obtained at the time was that the death was due to a failure of the respiratory muscles. The central stimulus seemed to be present and acting. These patients all made an effort to breathe but were unable to do so. Apparently the nerves to the muscles were anesthetized and the muscles became paralyzed. In one case, second gynecological, an attempt was made to maintain respiration with the respirator but this failed. This was apparently due to the fact that the patient had to be transported to another part of the hospital and the respirations were suspended too long for resuscitation to occur.

The question may be raised as to the relationship of ephedrine to these deaths. All of these patients received one ampoule (.05 gm.) of ephedrine before the spinal anesthesia was given. Labat believes that ephedrine has a direct relationship to spinal anesthesia deaths. He states, that "the contraction of the peripheral vessels cause a further anemia of the brain and that ephedrine has no action on the splanchnic area." I cannot agree with this. These patients did not die from cerebral anemia.

They were all in the Trendelenburg position and the pulse was obtainable for fifteen minutes after respiration had ceased. Ephedrine like all sympathico-mametic drugs acts directly on the nerve ends in the vessel walls which are not attacked by the anesthetic given intraspinally and there is some evidence for the belief that it may act on the smooth muscle of the vessel walls as well. Furthermore the fact remains that in cases of spinal anesthesia the blood pressure is maintained at or near the normal for that individual with ephedrine.

How can we account for these fatalities? I believe these patients all received an excessive dose of novocaine. In using a routine dose of 200 mg. of novocaine we were attempting to cover too many factors. We were trying to have an anesthetic agent that would last long enough for the slowest operator and would give a complete anesthesia of the entire torso. We entirely disregarded the question of individual susceptibility to the drug and we did not individualize the cases enough. We are therefore forced to the conclusion that it is absolutely impossible to establish a routine dosage of novocaine for spinal anesthesia in all patients.

At Harlem Hospital we had one untoward result following the use of spinal anesthesia.

CASE 1. Mrs. B. C. Admitted with a diagnosis of multiple fibroids. Her blood pressure was 160/90 and her general condition good. She was brought to the operating room and given two hundred milligrams of novocaine intraspinally at the level of the second lumbar vertebra with barbotage preceded by an ampoule of ephedrine. The patient was placed in high Trendelenburg position and a simple hysterectomy was performed. She left the operating room in good condition and was placed in bed in reverse Fowler's for two hours. The bed was then leveled. Six hours after the operation she went into collapse. Her condition closely resembled an acute intra-abdominal hemorrhage except that there was no reduction in the hemoglobin and that the abdomen showed no irritation of any kind. This patient received the usual stimulation, clysis of saline

and glucose with very strenous stimulation by digitalis, adrenaline, etc. She was very ill for about forty-eight hours and then made an uneventful recovery. There were 2 cases similiar to this that occurred in another hospital which I should like to include here.

Case ii. Patient operated on for the removal of the prostate. His blood pressure was 190/100. The first stage was performed under local anesthesia and the second stage under low spinal. The injection was given at the level between the third and fourth lumbar vertebra, 120 mg. of novocaine inserted in the spinal canal with barbotage plus novocaine-ephedrine for skin. The operation was completed without any difficulty whatsoever. The patient left the operating table fifteen minutes after the operation had begun in excellent condition. He was returned to bed and placed in reverse Fowler's position for two hours at the end of which time the bed was again leveled. At eight o'clock that evening seven hours after the injection of the spinal anesthesia the patient went into a definite circulatory collapse. During this collapse he presented all the symptoms of severe secondary hemorrhage. The wound was carefully examined but no bleeding was discovered and hemoglobin estimates made every hour showed no change. The patient responded to stimulation and after about five hours his blood pressure rose to 90 mm. of mercury and stayed there until about eight o'clock the next morning when the patient again went into a circulatory collapse and died.

Case iii. Mrs. B. B. The patient was admitted to the hospital in apparently good condition. Her blood pressure was 120/80 and the patient had multiple fibroids of the uterus. One hundred and twenty milligrams of novocaine were injected at the level of the second lumbar vertebra with barbotage, novocaine-ephederine for skin. The patient was placed in Trendelenburg position and the operation performed without difficulty and no apparent ill effects. The patient left the operating room table forty-five minutes after the spinal anesthesia was given. She was placed in reverse Fowler's for two hours and then the bed was leveled. About five hours after the operation the patient went into a condition of circulatory collapse. She gave every symptom of a severe secondary hemorrhage except that there was no drop in the hemoglobin. The patient was given the usual stimulants, adrenalin, clysis,

glucose intravenously, etc., but she was unable to overcome the collapse and died twenty-four hours after the operation.

This brings us to a very important topic for discussion and that is what is the effect, immediate and remote, of spinal anesthesia on the circulatory system? We know that spinal anesthesia causes a dilatation of the splanchnic vessels with a possible diminution of circulating blood volume and a general reduction in the blood pressure. To compensate for this other blood vessels contract and the heart becomes more rapid.

It has long been contended by a great many men that spinal anesthesia is the anesthesia of choice in all cardiac cases and in individuals with hypertension. I cannot subscribe to this idea in its entirety. The objection to inhalation anesthetics, gas or ether, is that they cause a sudden rise in the blood pressure and the demands on the cardiovascular system for readjustment are too great. How do these demands differ in spinal anesthesias? Here instead of a rise in pressure we have a marked and sudden drop during the anesthesia. The readjustment required during the anesthesia and after the anesthetic agent wears off may well exceed the capacity of the circulatory apparatus in patients with hypertension or heart disease.

Labat in his recent article asks "why should we be afraid of the presence of the low blood pressure since we are certain that when a patient dies it is not from low blood pressure but from anemia of the brain?" This may be quite true although our 3 fatalities do not bear this out, but is it not the sudden drop in pressure which causes the anemia of the brain resulting in the fatalities that occur while the patient is still on the operating table? May not the circulatory demands produced by the prolonged vasodilatation in the splanchnic area result in a fatigue in the vascular system in susceptible individuals accounting for some of our cases of late circulatory collapse after spinal anesthesia?

The fact remains that six or eight hours after the anesthesia some of these patients

do develop a cardiovascular collapse resembling shock after spinal as well as after general anesthesia. I regret my inability to make a complete report on this type of case. We are at the present time studying a series of spinal anesthesia cases with the electrocardiograph; taking tracing before, during and after the operation. Another study that should prove of great assistance in formulating a conception of the circulatory disturbances in spinal anesthesia would be the blood volume determination before, during and after the injection of a spinal anesthetic.

CONCLUSIONS

1. There is no question that spinal anesthesia has its place in surgery. There is no question that spinal anesthesia should be used in surgery in certain definite cases when indicated. But, we do not feel that spinal anesthesia should be the anesthesia of choice as a routine method of anesthesia in all cases on any large surgical service.

2. We feel that spinal anesthesia should not be given by an interne or by anyone other than a physician anesthetist whose sole object is to train himself thoroughly in the use of the various anesthetic agents. By placing spinal anesthesia in the hands of such an individual you are assured that the proper amount of attention will be given to the minor details which go so far and do so much toward making spinal anesthesia a success.

3. We feel that 200 mg. of novocaine should not be used as a routine in all cases and we have discontinued the practise at Harlem Hospital. The dosage should be varied according to the patient, his temperament, his weight, the type of operation and the operator.

4. The use of barbotage to the extent of 10 c.c. is contraindicated as a routine.

5. We do not feel that spinal anesthesia is the anesthesia of choice in operations above the diaphragm. In upper abdominal conditions spinal anesthesia gives excellent relaxation, but we must expect to occasionally obtain some effects we do not desire.

In low abdominal operations lasting a long time a large dose (200 mg.) of novocaine is indicated without barbotage and dissolved in 5 c.c. of spinal fluid.

DISCUSSION OF PAPERS BY DRS. SAKLAD AND FALK

DR. GASTON LABAT: It was very gratifying to me to hear all that has been said concerning spinal anesthesia, a method which in the past has given so many bad results. At one time, confidence had been restored in the method; but the simplicity of its technique rendered it so popular that its wholesale use became the order of the day. The disastrous results which have been reported within the last few years have greatly shaken this confidence.

The various solutions advocated at the time and which have almost returned to favor will always give bad results, for the good reason that the action of solutions of various specific gravities which are introduced into the subarachnoid space cannot be considered on the same basis as identical solutions placed in test tubes.

In order to produce anesthesia there must be some physiological or chemical reaction with the nerve substance or with the living tissues surrounding it; conductivity must be abolished from the periphery to the central system, or the reflex arc must be broken. Spinal anesthesia induced by injection of the anesthetic drug alone, a simple drug, dissolved in the patient's own cerebrospinal fluid is, to my mind, the best technique.

It is impossible to prevent the fall of the blood pressure, a condition which I have called circulatory disturbances. The blood pressure will always be lowered following the injection of an anesthetic drug into the subarachnoid space, particularly if the anesthetic solution injected has reached a certain number of vasoconstrictor fibers involved in the sympathetic elements supplying the splanchnic area. There will always be a drop in blood pressure, until we find a drug which is capable of acting on the sympathetic system alone, as a mordant, preventing the anesthetic drug from inhibiting its fibers. Thus the drug would be free to act on the sensory and motor roots alone. Lowering of blood pressure is not only caused by the relaxation of the splanchnic blood vessels, but is a result of muscular relaxation. All blood

vessels in the economy with the exception of those of the brain are supported by muscles and aponeurosis. When these muscles become relaxed the blood vessels are bound to relax. The blood vessels relax, therefore, not only because they lack the control of the sympathetic system, but because they lack their usual supporting muscles. The muscles are in a state of complete relaxation, as a result not only of the action of the drug on the motor nerves, but of a break in the circuit or reflex arc.

Deaths have been reported, it is true. I have already said elsewhere what I had to say concerning ephedrine. It is useless for me to repeat it tonight, except to say that the principal action of ephedrine is to cause considerable depression and circulatory collapse after stimulating for a relatively short period of time. When the depression comes death may be near. This may perhaps explain many of the deaths that have happened. If a patient receives a spinal anesthesia and is placed immediately in the Trendelenburg position, and if that position is maintained during the entire operation, the time of the transfer of the patient from the operating table to his bed, and for three hours at least after the patient has been placed in bed, I see no reason why death should occur. I have had none up to now and I hope that I will not have any. I have given spinal anesthesias to many bad surgical risks.

In trying to compare the circulatory condition observed during spinal anesthesia to that associated with shock, I shall simply quote the following example. A few years ago I was called by Dr. Arthur Wright at St. Vincent's Hospital. There, was a young man who had had an accident. He had been run over by a train in the subway. He was an out-of-town boy, under age and the hospital waited for the usual consent. The accident had happened at seven o'clock in the evening and at three o'clock we started operating on him. He had been unconscious since his arrival in the hospital and when he was brought to the operating room he was still unconscious. Ten minutes after the spinal anesthesia had been administered he regained consciousness and talked to us on the operating table while his leg was being amputated. This is, I believe, sufficient evidence that shock, at least traumatic shock, is quite different from the circulatory condition associated with spinal anesthesia. As soon as the effects of the trauma on his central nervous

system disappeared by the blocking of the nerves as the result of a spinal injection, the inhibition caused by the shock disappeared and the boy spontaneously, on the operating table regained consciousness and told us the whole story of his accident.

It seems to me, as Dr. Falk said, that in the last few years spinal anesthesia having become very popular we are placing it in the hands of inexperienced men, and we are trying to make it a routine procedure, and Dr. Falk has been trying also to use a routine dose, viz., 200 mg. in every adult. He was right in concluding that 200 mg. are too much. I have given 200 mg. only twice in my career. I think 150 mg. are all that is necessary for any operation below the diaphragm. This is the average dose. The use of 100 mg. is recommended for operations lasting half an hour. We should try to place the method in the hands of those who know something about it.

Dr. Hyppolyte M. Wertheim: Spinal anesthesia has come to the front: I feel that it is being used promiscuously. I have said it before and I again take this opportunity to repeat it. Spinal anesthesia or analgesia, as it should be rightly called, is being used where sacral anesthesia and paravertebral anesthesia should be employed. Any man using spinal anesthesia for hemorrhoids or in-growing toenails and things of that type, is really performing a criminal act in surgery. We owe it to the patient to be honest with him. It is known that spinal analgesia has associated fatalities. In spite of what everybody else, or any one else may say, fatalities do occur in the simplest types of techniques, and those fatalities are inexplicable, as a rule.

I do say that the simplest technique is the best. There is no question but that neocaine or novocaine plus a simple Labat technique is the safest procedure. But still, in offering anesthesia to a patient, one must be very careful. In your case indicates a general anesthesia, by all means use general anesthesia. If novocaine anesthesia is indicated use that. Along these lines, may I say that it is for the anesthetist to decide whether a general anesthesia, spinal or field block should be given. It is up to the anesthetists to train themselves in each field of anesthesia.

Until recently, there were many surgeons doing field blocks and spinal anesthesia, and calling a man in to give a spinal only when he thought it was necessary. I do not think the

surgeon is absolutely qualified to judge whether or not a simple case should have gas, oxygen, local or field block anesthesia.

I take this opportunity once again to invite general anesthetists to become more interested in this work, because spinal anesthesia and novocaine anesthesia are certainly making rapid advances. The surgeons are gradually losing their hold on the entire subject. This is an appeal for anesthetists to become interested in this work and help further the studies in spinal and field block anesthesia.

DR. SIMON D. EHRLICH: One subject that impressed me in Dr. Falk's paper was the question of the individual susceptibility. That is something that has been going on in my mind. The more I give spinal anesthesia, the more I feel that this is an unknown quantity. We do not know which patients are susceptible to novocaine. We know that it has happened, that a little novocaine solution injected into the tonsillar pillars has caused death. I think that this idiosyncrasy accounts for some of the deaths under spinal anesthesia. The more I see of it, the more do I feel that there is a distinct mortality to spinal anesthesia; and it does not make any difference whether you use neocaine or any of the other preparations. Many who use neocaine, and according to the technique of Dr. Labat, have had fatalities. In other words, there is something more to it than the question of technique, or the drug used. Men who do 100 cases or 500 cases may escape a mortality. The men who give thousands of spinal anesthesias are going to get mortalities. The more you do, the more you are likely to strike the patient that is susceptible.

DR. WINFIELD S. PUGH: About a year ago the head of a large institution came to me and said, "Pugh, unquestionably you have about the poorest class of risks in the hospital. Are you satisfied with your mortality rate?"

We said, of course, we were not, He said, "What do you use for anesthesia?"

We said, "Either block or spinal anesthesia."

He said, "Why don't you try some ephedrine with it?"

So in a series of 50 urological cases in which we used spinal anesthesia we tried ephedrine. In not a single one of these cases did we notice any improvement whatever. We had our falling blood pressure just as we had without it. In fact, in some of the cases we seemed to think it was intensified.

There was another point too. One or two of these patients cases were thought to be doing poorly after spinal anesthesia, and they were given intravenous infusions, with unsatisfactory results.

DR. SAKLAD spoke of spinocaine. We had been trying spinal anesthesia in nephrectomy, and in all kidney operations, and I regret to say our results were not satisfactory. We did not get the proper degree of anesthesia. In fact, we did not think we got the anesthesia we did with paravertebral. I had given up paravertebral because I thought it was a pretty big operation in itself. We tried spinocaine and we got no greater diffusion with it than we did with the straight novocaine. I believe the agitation regarding spinocaine is based on a false conception of diffusion, and think the physiological action is very much different from what we generally anticipate, or what its sponsors anticipate.

When spinal anesthesia was first introduced a number of years ago, during my internship days we had five straight fatalities following spinal anesthesia, and 1 case of a paraplegia which took about six months to clear up. As the result of this, all activities in spinal anesthesia were stopped, and I must say that I heard very little of the fatalities from spinal anesthesia until very recently. One or two of our members like Dr. Falk have had the courage to report them.

DR. LOUIS ABELSON: Dr. Falk's paper shows a definite attempt to be honest in appraising spinal anesthesia. There is one fatality that came to my attention which I believe I ought to mention. A woman about sixty years of age was rushed into the hospital with diagnosis of acute gall bladder. She was placed on the table two hours later and I gave her 150 mg. of neocaine in the second and third lumbar interspace and placed her in the Trendelenburg position immediately after. The surgeon made his incision as soon as the anesthesia was well established. As the gall bladder was exposed she complained of respiratory difficulty and expired. Measures for resuscitation and artificial respiration were unsuccessful.

The body was sent to Bellevue at the instance of the medical examiner. We received an autopsy report of a large cardiac infarct and a coronary thrombosis. I make mention of this case so as to stress definite pathology in a spinal death. Another point I would like to stress is that I have yet to see a spinal death

in any case for surgery which might not have resulted if a general anesthetic had been administered.

DR. FALK: I am afraid Dr. Saklad did not quite understand the question. I did not raise the question of the advantages of spinal over a general anesthetic in a hypertension case. The question is: Shall we regard spinal anesthesia as the ideal anesthetic in a hypertension case? So many men advocate it. So many men state that in a patient with hypertension plus let us say a gall bladder, give spinal anesthesia. We have not found this to be so. We have had a mortality from our hypertension plus gall bladder cases with spinal anesthesia where we feel that the death was due to a cardiovascular collapse. We cannot help but feel that the spinal anesthesia was as much responsible for that cardiovascular collapse as if the patient had received a general anesthetic. I was very careful in the list of my fatalities from spinal not to include cases where the cause might be questioned.

We had three other fatalities which I did not include. One was a patient having a ventral hernia with strangulation and obstruction of four days' duration. She died on the table thirty minutes after the spinal was given when the obstruction had already been released. I felt that this was probably an embolic and not spinal death.

The second case was almost identical except that an autopsy was obtained and the embolus verified.

The third case was also intestinal obstruction. This patient died as do patients from general anesthesia. The patient on being placed in the Trendelenburg position vomits tremendous amounts of fluid and practically drowns himself.

The three deaths I reported in the paper were cases which we classified as operations of choice in good surgical risks. Two of them were gynecological cases, the third was a decapsulation of the lung. The deaths all occurred within twenty minutes of the giving of the spinal and before any operative procedure had been begun. All the cases were autopsied and nothing found. I feel that spinal must be held responsible for these deaths.

DR. JHEINS AMSTER.—It is only in recent years that our interest in intraspinal black has been revived. Its value as a life-saving measure in abdominal surgery has been called to our attention by men who have had vast experimental and clinical experience with this method.

This valuable aid now gives us an opportunity of operating on a class of patients who have heretofore been considered hopeless surgical risks on account of the additional danger of general anesthesia.

The popularity of this procedure is due in a large measure to the introduction of the Labat technique which is simple, to the choice of an anesthetic agent, namely neocaine or novocaine, which is safe, and to end-results that are far more satisfactory and successful, than those obtained with inhalation narcosis.

The modern use of spinal anesthesia not only improves the operability, but it shortens the convalescing period, and reduces the mortality rate of the aged and the poor risk, who must undergo surgical intervention.

Until recently, there were definite obstacles in the way of making intraspinal block a safe method for abdominal operations, but since the introduction of the Labat technique, many of the objectionable features of the old spinal procedure have been removed.

My experience with spinal anesthesia dates back to 1905 when I began to use cocaine, then eucaine and later on stovaine intraspinally, in operations upon poor surgical risks.

I realize now, how crude and how dangerous this procedure was, as compared with the more modern method of spinal anesthesia. We encountered numerous accidents and a few fatalities with the old method, which were attributed to poor technique and to the deleterious action of these anesthetic agents and we therefore abandoned this method.

In the early part of 1922 I became intensely interested in the spinal technique as devised by Dr. Labat and I have used this method in 1000 operations up to July, 1928 with gratifying results. This group includes practically every type of operation on the gastrointestinal and biliary tracts and genitourinary and female generative organs. Hernioplastics and operations on the lower extremities are included in this series.

These cases with few exceptions were considered poor of unfavorable risks resulting from old age or some organic disease. Some of them had diabetis, nephritis, bronchitis, emphysema, pulmonary tuberculosis, pneumonia, pleurisy, influenza, cardiac disease, cirrhosis, of the liver, advanced arteriosclerosis, measles, whooping cough, carcinoma of the abdominal organs,

etc. Others showed evidences of extreme anemia, cachexia, inanition, disturbed metabolism, advanced dehydration, acidosis, acetonuria, uremia etc.

This series in reality comprises 1189 instead of 1000 operations, as in numerous instances two or more operations were performed on the same patient at one sitting. Neocaine or novocaine was used and the Labat technique was employed.

The oldest patient was eighty-eight years and the youngest four years of age. Twenty-seven patients were considered hopelessly inoperable by surgeons who were accustomed to operate exclusively under general anesthesia. Twelve of this group were almost moribund when we operated, yet with the use of intraspinal block a favorable prognosis was made possible in 8 cases. Three hundred forty-six of this series were emergency operations.

Perfect anesthesia was obtained in 954 cases with 46 partial or complete failures. Nearly all of our failures occurred during our early experience with this method. We attributed 33 poor results to apprehension and unwillingness of patients to cooperate. Eight failures were due to faulty technique and in the remaining 5 cases the drug was found to be inert.

In 13 prolonged operations, abdominal field block supplemented spinal anesthesia and in 22 instances it was necessary to resort to general anesthesia after the effects of the spinal anesthesia had worn off. (We are now using larger doses of neocaine and the anesthetic time is more prolonged.) In 21 cases we found it rather difficult to enter the subarachnoid space on account of obliteration of landmarks.

Ephederin was employed in 75 operations— Only momentary or transitory changes in blood pressure were noted in 17 cases and in the remaining cases no material rise in pressure was noticed.

Occipital headaches and stiffness of the posterior group of neck muscles were present in 59 cases. Headaches have since been largely overcome by boiling the syringe and needles in distilled water instead of tap water.

Tactile sensation was sometimes retained and some patients felt a pulling sensation which they apparently misinterpreted in their minds as pain.

We found that with high spinal there was anesthesia of the lower intercostal muscles and the diaphragm was therefore called upon to do extra work resulting in difficulty in breathing.

There were 29 deaths. None of the deaths could be traced directly to spinal anesthesia.

Advantages: The patient is conscious and there is no danger of aspirating mucus or other irritating substances into the trachea or bronchial tubes which sometimes occurs with general anesthesia resulting in pneumonia or lung abscess.

Anesthesia of the abdomen and lower extremities occurs almost instantly. Complete abdominal relaxation is afforded. Contraction and collapse of the intestines are present thus allowing thorough abdominal exploration.

Bleeding is diminished or absent. Operative shock is reduced to a minimum. Fluids are usually given before, during and immediately after operation, which tend to alleviate thirst and prevent acidosis.

Postoperative nausea, vomiting and abdominal distention are uncommon. Hepatic and kidney insufficiency and cardiac failure are not likely to occur.

The surgeon operating under spinal anesthesia realizes that the anesthetic time of novocaine is limited, and he therefore does not waste any valuable time. In short, he endeavors to exercise a sense of precision, speed and dexterity which tend to minimize the danger of surgical shock.

As for some surgeon's fear that spinal anesthesia is unsafe and unreliable, it apparently has not proved that way in our hands. However, we maintain, that intraspinal block in inexperienced hands, is a very dangerous procedure, and on the contrary, when skillfully administered, it is less dangerous and more dependable than general anesthesia.

Spinal anesthesia in our opinion is no longer an experiment. Its advantages are self-evident. It has already reached a strong hold in surgical practice and it apparently is here to stay.

EXTRAPLEURAL THORACOPLASTY PERFORMED UNDER SPINAL ANESTHESIA*

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CHICAGO, ILL.

WE wish to report 7 cases of extrapleural thoracoplasty performed under spinal anesthesia. Five of these were for pulmonary tuberculosis and 2 for lung abscess.

For several years we have been performing our extrapleural thoracoplasties with the aid of local infiltration and block anesthesia or with ethylene. We have never been satisfied with either. In stout individuals the infiltration is difficult and often unsatisfactory. Ethylene anesthesia would be ideal if all patients took the anesthetic and recovered from it with ease, and if it were possible to keep the patient "light enough" so that the danger of inspiration of mucus from the pharynx and mouth were not present. After having successfully used spinal anesthesia for operations on the upper abdomen in a large number of cases in the general surgical service of one of us, we decided to attempt to use it in chest cases.

We selected for our first case a young adult with a chronic abscess in the upper lobe of the left lung, who had just recovered from a severe pneumonia. A compression of the upper lobe was deemed urgently advisable because of hemorrhage. With the aid of a novocaine spinal anesthesia large sections of the third, fourth, fifth, and sixth ribs were removed. The anesthesia was excellent and the postoperative course so satisfactory that a week later we decided to use spinal on another case of lung abscess, this time of the lower lobe. Here again large portions of the ribs were removed amounting to virtually a lower stage typical extrapleural thoracoplasty, and here again the anesthesia and the postoperative course were as satisfactory as our experience in upper abdominal surgery had led us to expect.

Since then we have used spinal anesthesia in 5 selected cases of extrapleural thoracoplasty for pulmonary tuberculosis.

In the first 2 cases we tried it only for the first stage of the operation, which consisted of the six upper ribs in 1 case and the five lowers in the other. In the second stage we gave ethylene. These patients therefore had an excellent opportunity to compare the two anesthetics and both were emphatic in their preference for the spinal. In both cases the recovery following the stage performed under spinal anesthesia was much smoother than we had ever seen with ethylene.

In the last 3 cases spinal anesthesia was performed for both stages. In one of these we did not get a satisfactory loss of sensation in the upper part of the wound and for the removal of the upper ribs a light ethylene anesthesia was given.

Whether or not the failure to obtain satisfactory anesthesia in the upper part of the chest cavity was due to faulty technique or to an over cautiousness in not increasing the dose of novocaine remains to be seen. We will admit for the present that we prefer to use the technique as hereafter outlined even if in an occasional case a small amount of ethylene must be given.

We usually perform the second stage ten to fourteen days after the first stage. We have noted no ill effects from the repeated use of a novocaine spinal anesthesia. In our general surgery we have at times repeated a spinal anesthetic within five days and many authors have reported cases in which for one reason or another a second spinal anesthesia was given within twenty-four hours of the first.

Our technique varies from that used for abdominal operations in only a few points.

We perform our spinal punctures in the usual site, that is between the third and fourth lumbar vertebrae. We use a small bore needle and allow the fluid to drop out slowly catching it in a sterile beaker. When the desired amount has been obtained, the novocaine crystals are dissolved in it and the solution is slowly re-injected into the spinal canal.

In small individuals and for the lower ribs 200 or 250 mg. dissolved in 6 c.c. of spinal fluid suffice; in larger individuals and for the upper ribs 8 c.c. of spinal fluid are withdrawn and 250 mg. of novocaine used.

The injection is made with the patient lying on the side to be operated upon and the back curved outwards so as to spread the spines of the vertebrae. After the injection the table is slightly tilted so as to lower the shoulders; the head itself is rested on a pillow. The patient is turned on his back and is tested from time to time for the loss of cutaneous sensation. When the anesthesia has reached the desired height, the patient is turned over so that he lies flat on his stomach, his forehead resting on a soft pillow and the arm on the side to be operated upon hanging over the edge of the table supported in a sling; a small pillow is usually placed under the abdomen.

This incidently is the position we used long before we ever thought of spinal anesthesia.

An intramuscular injection of ephedrine is always given just before making the spinal puncture. Blood pressure readings are made every few minutes during the operation and the pressure is controlled either by still further lowering the head of the table or by intramuscular injection of ephedrine. On the whole, we agree with H. Koster and L. P. Kasman[1] that the condition of the patient is much more important than the blood pressure readings and that as a rule lowering the head of the table so that sufficient blood will gravitate from the relaxed abdominal veins to the heart is all that is necessary to counteract any pressure changes. In chest operations, with the patient lying on his abdomen, the dilatation of the splanchnic veins is a more serious matter, but as I said we have had no trouble in controlling the blood pressure with the combined aid of gravity and ephedrine.

We realize that this is a small series of cases but our experience with spinal anesthesia in these cases was so gratifying from the standpoint of both the patient and ourselves that we feel that this type of anesthetic has a great deal to offer in well selected cases.[2]

[1] *Surg. Gynec. Obst.*, 49: 617–630, 1929.
[2] Since submitting this paper for publication we have had 3 more cases of extrapleural thoracoplasty for pulmonary tuberculosis under spinal anesthesia, in all 3 the spinal anesthesia being adequate for the upper as well as the lower ribs.

COMBINED NOVOCAINE-NUPERCAINE SPINAL ANESTHESIA*

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AFTER an intensive study and extensive clinical trial of the several different techniques of inducing subarachnoid block, one is quite apt to become acquainted with the possibilities and limitations of the many novocaine preparations now in common use for spinal anesthesia for major, general surgery. In consequence it can be said, without fear of contradiction, that the most trying problem encountered, no matter what agent or method is used, is to produce an anesthesia which lasts long enough for the occasional operator who takes a considerable time for his surgery, or for the fast and skilled surgeon when he operates on that infrequent patient who, from the nature of the surgical difficulties presented, requires prolonged anesthesia, i.e., anesthesia which should last up to or in excess of two hours. It is easy to show that this is not a difficulty experienced by any one particular anesthetist, as the following quotations, taken verbatim from the literature, will prove.

Rankin and McCuskey[16] state:

In a series of 325 operations on the colon or sigmoid for colostomy, ileocolostomy, or anterior resection—in 12 per cent it was necessary to use some form of general anesthetic either because the spinal anesthetic failed or because the anesthetic did not last until the completion of the operation.

Evans[4] says: "There is a definite limit to the duration of spinal anesthesia. Operations requiring time greater than this limit must either be started or finished under general anesthesia." Labat[13] writes: "The duration varies from forty-five minutes to one and a half hours."

There is nothing quite so embarrassing or quite so disappointing to both the surgeon and the anesthetist, neither is there anything quite so difficult to explain to the patient, nor can there be anything quite so certain to bring odium down upon spinal anesthesia from both the general medical profession and the laity itself, than the factor of failure to produce anesthesia long enough for the operation at hand. This is true because those who would condemn spinal anesthesia on account of its previous limitations, have but little comprehension of the difficulties involved and are ignorant of the restrictions often encountered with the heretofore known drugs and methods.

Through intensive personal experience, by close study, and by the keeping of exceedingly accurate records of every clinical case in which the different modern forms of spinal anesthesia were exemplified, an effort was made to solve this problem, in the past, by variations in technique so that large doses of novocaine in exceedingly small concentrations of solvent were employed; and, using either spinocaine, gravocaine, novocaine, or neocaine, with this small-volume, high-concentration technique, it has been possible to guarantee to the surgeon an anesthesia for a period of time up to one and a half hours. This has been reported in the literature.[18] However, *beyond such limits*, it was deemed that even a skilled anesthetist would be inviting trouble by subjecting the patient to an anesthetic hazard altogether out of proportion to the surgical risk, despite the undeniable fact that occasionally surgery will last up to two hours or longer.

Consequently, when the first accounts on the use of nupercaine (percaine) began to appear, the employment of this drug in subarachnoid block was followed with intense interest, because of the striking feature, reported from different sources, that such spinal anesthesias lasted a long time, from a few hours up to as many as nine or ten hours. Also prominent among

the concomitant factors discussed, was the item that while the anesthesia seemed to take a somewhat more lengthy period of time to become effective, yet good anesthesia apparently was being obtained by relatively small doses of the drug, such as 5, 10, and up to 15 mg.

During the past year, notably in the foreign literature, the references to nupercaine (percaine) have been plentiful; and, while it is true that many of these seemed complicated and contradictory, yet, with all the chaff, it seemed possible to winnow out a basis for constructive theorizing and subsequent clinical trial.

It is not the province of this thesis to dwell upon the chemical structure and toxicity of nupercaine; as, for these facts, the reader is referred to publications in the recent literature. Suffice it to mention that nupercaine is a quinoline derivative and hence related to quinine, that it is ten times more effective than cocaine and twenty times more powerful than novocaine. Therefore, it may and should be *used in very small doses.* Also, it must be prepared in acidulated buffered solution to prevent precipitation within the spinal canal.

In order to explain the basis upon which the theory of the effectiveness to be derived from a combination of novocaine and nupercaine was established, quotations from the literature are of interest. Quarella[15] states: "We have used nupercaine in doses of 5 to 15 mg.; collapse symptoms have never been observed." Konrad[12] writes: "Using 8 mg. doses, the anesthesia averaged four hours and thirty-six minutes. Anesthesia occurred slowly. Disappearance of true anesthesia was followed by a condition of strongly diminished susceptibility to pain, eight to ten hours." Ziegner[25] has written, after performing numerous operations on the lower half of the body:

Never have gone above 10 mg., usually only 8 mg. Collapse is due to the fact that nupercaine is lighter than spinal fluid and ascends to thoracic cord. Frankly, the ideal sought for has not been attained. Collapse

limited by not going over 8 mg. and limiting ourselves to lower half of body.

Steinbruck[20] says: "Using 1.5 c.c. 1 per cent nupercaine had anesthesia, in different cases, five and a fourth hours, five hours, six and a half hours." He also speaks of collapse and severe emesis, and states that he had mild to severe symptoms of collapse in 6 out of 12 cases. Christ[3] writes: "4 c.c. of 1 to 1000 solution gives anesthesia six to ten hours." Henschen[7] states: "0.5 c.c. 1 per cent solution, anesthesia to umbilicus lasting six to ten hours. Nupercainismus manifested by somnolence, persisting several days." Flörcken[5] says: "4 c.c. of 1 to 1000 solution, anesthesia was not satisfactory. The correct dosage for spinal anesthesia must yet be determined." Keys[10] states: "Anesthesia perfect in 36 out of 46 cases. Now using 2 c.c. of 1 to 200 solution. No intoxication." His cases were all kidney, bladder, and urologic in character and the duration varied from one and a half to twelve hours. He also says: "Minimal reported lethal dose 90 mg." Lake[14] writes: "The anesthesia takes somewhat longer to develop than that with novocaine, but the rate varies, of course, with the concentration employed. It may last up to six hours, again depending on the dose and concentration." Jones[9] reports: "Dorsal roots must be well soaked after the injection by placing the patient on his face." He recommends this for five minutes after making the injection.

From these excerpts it was thought possible to make certain tentative deductions. First, it appeared that while the anesthesia might be slow in becoming effective, especially with the small doses of 5 to 7½ mg., yet once it became established, the anesthesia appeared to last upwards of four to six hours. Secondly, Ziegner[25] and Jones[9] made rather parallel observations with reference to the lightness in specific gravity of the nupercaine solution, in that they refer to the necessity of soaking the dorsal roots. It appeared probable, therefore, that if a preparation of

nupercaine could be made which was somewhat heavier in specific gravity than is spinal fluid, that the previously mentioned objectionable feature would be overcome and that particular problem solved. This is readily understood by those familiar with the action of, and anesthesia produced by, such solutions in the subarachnoid space. Thirdly, it seemed that if some mixture or combination of nupercaine with other drugs were possible, so that the anesthesia would be very rapid or almost instantaneous in coming on, and if this mixture or combination of drugs in solution had certain inherent elements of control, so that the anesthetist could tell how it would behave within the spinal canal, and, finally, if the mixture still remained within the limits of toxicity, then it appeared probable that an anesthetic solution would be had which would be almost ideal for prolonged surgery, whatever the character of the operation might be.

Following the preliminary premises, theorizing was done. As is well known to all spinal anesthetists, novocaine (neocaine), when dissolved in spinal fluid and reinjected into the spinal canal, produces almost instant radicular block; it seemed then as though novocaine was the logical drug to add to nupercaine in order to produce the quick and early anesthesia which is so lacking when nupercaine alone is used, thus having a solution or mixture in which the novocaine would give the quick and early anesthesia while the lasting qualities of the anesthesia would be maintained by the more slowly acting nupercaine. A few simple experiments were sufficient to show that novocaine, in almost any reasonable amount, when dissolved in buffered 0.5 per cent or 1 per cent nupercaine solutions, would not precipitate either the novocaine or the nupercaine; and, hence, it was reasoned that they were compatible. Also, previous experience with novocaine dissolved in spinal fluid, especially when the concentration was high, such as 200 to 300 mg. of novocaine dissolved in 1½ to 2 c.c. of spinal fluid, showed that the resultant

solution was higher in specific gravity (heavier) than spinal fluid, the specific gravity of spinal fluid being 1.007, and that of a mixture of 10 per cent novocaine dissolved in spinal fluid being 1.025. Consequently, when to buffered nupercaine solution is added sufficient novocaine to make a 10 per cent novocaine mixture, the resultant solution has a specific gravity of approximately 1.018. These factors then give a novocaine-nupercaine mixture which is slightly heavier in specific gravity than is spinal fluid, and thus it is possible to overcome the objectionable qualities which Ziegner[25] thought produced collapse in his patients by producing predominatingly anterior root block; also, such solution is readily controllable within the spinal canal and affects the posterior roots more than the anterior, preventing the symptoms concerning which he wrote. It does away, too, with the necessity, described by Jones,[9] of turning the patient on the face for five minutes after the injection in order to soak the dorsal roots. Still further, when used in *small volumes*, not to exceed 2 c.c., and when injected *slowly*, a most pertinent element of control as to the extent of the anesthesia on the surface of the body resides in so tilting the table that the patient's head and shoulders are slightly higher than the lumbar region of the cord. Finally, it was thought that in this combination one could do away with the large doses of novocaine, such as 300 mg., since it is well established that, under proper technique, 150 to 200 mg. of novocaine when dissolved in spinal fluid will produce anesthesia to the nipple line; and, at the same time, it was felt that the smaller and less prohibitive doses of nupercaine, such as 5 to 7.5 mg., could be used; it was hoped that the resultant anesthesia still would remain effective approximately two and one-half hours. All these theories proving correct, a solution would be had which would be very rapid in the preliminary anesthesia, owing to the novocaine action; and, since it is well established that this novocaine effect would persist for at least

forty minutes, then it would not matter even if the small dose of nupercaine did not take hold for twenty or thirty or more minutes. It was only desired that these minimum doses of 5 to 7.5 mg. of nupercaine would give a reasonable expectation of two and a half to three hours of anesthesia, and this was felt to be all that any surgeon could ask or demand. An additional aid in this theorizing was the fact that, chemically, novocaine and nupercaine are structurally different.

After the completion of the theory, the problem of diffusion and gravitation was worked out in an artificial glass spine by means of colored solutions. It was found, with delight and satisfaction, that the mixture behaved exactly as do the concentrated novocaine solutions in spinal fluid, and that the same factors of control within the spinal canal obtain; namely: That the height of anesthesia on the surface of the body can be governed by the following five variables: (a) Amount of dosage used. (b) Amount of solution reinjected into the spinal canal. (c) Rate or force of injection. (d) Location of interspace used, whether L1, L2, L3, or L4. (e) Plane or position of the table.

All anesthetists who have a full understanding of the value and use (or *abuse*) of these five variants, readily can see that at this point the step to the clinical application of a combined novocaine-nupercaine subarachnoid block was easy, reasonable, rational, and *safe*.

The technique is simple. The patient is prepared and spinal tap is made just as in any other form of spinal anesthesia. However, here too, meticulous attention to having exactly the right size and quality of syringes and needles, and to the keeping of these in perfect condition, pays huge dividends of finesse and success. Before making the tap, all needles, syringes, ampules, etc., having been thoroughly sterilized by boiling or autoclaving, the anesthetist will have loaded a small Luer-Lok syringe with the estimated quantity of buffered nupercaine solution in which the required amount of novocaine has been dissolved. As soon as the tap is completed, the syringe containing the novocaine-nupercaine mixture is attached to the spinal needle, and sufficient spinal fluid is allowed to flow back into the syringe, of the patient's own intraspinal pressure, to bring the total bulk up to 2 or 2.5 c.c., depending on dosage, height of anesthesia desired, interspace used, and rate or force of injection, as mentioned in the paragraph under variables. Here is where judgment is needed. Then the mixture is injected *slowly*. The site of puncture is covered or sealed; the patient is quietly and easily turned on the back; the nurses prepare the field; the height of anesthesia is tested; head and shoulders are raised slightly; the surgeon begins to operate. The anesthesia is practically immediate. Its height, unless excessive dose of either or both drugs has been injected, is controllable by the degree of Fowler's used until such time as the solution has become entirely fixed. It must be remembered that, as compared with novocaine, the blotting out or fixing of the nupercaine element of the solution by the nerve tissues will take longer, because the primary nupercaine effect is slower in coming on; hence the Trendelenburg position must not be used too early.

This method is so much more simple and so much more certain than that described by Jones[?] that there can be no comparison. He uses hyperbaric, hypobaric, and isobaric solutions of nupercaine and saline, injecting as much as 15 c.c. to 18 c.c. of these solutions *under pressure*. He speaks of measuring the length of the spine but says nothing about its diameter, which also is known to vary. With the method of diffusion and gravitation, here described with *small-bulk* injections, a considerably greater degree of control is obtained. The rate of diffusion is fixed and certain; the gravitation can be regulated by the level or plane of the spine.

It easily could be questioned whether injecting routinely 15 c.c. to 18 c.c. of

solution, as advocated by Jones,[9] might be dangerous. Sterne[21] and Carter[2] think that it readily could. Jones[9] himself, states: "When pressure is felt a pause is made—and a pause between each 2 c.c. is, I think, good practice." This would mean nine pauses in an 18 c.c. injection. Knowingly or not, he is allowing for certain readjustments to take place. Still further, he apparently doubts the wisdom of these larger volume injections; for, he states later: "With practice the smaller volumes are becoming more uniformly successful." The technique disclosed in this thesis is a very small-volume injection.

There is no effort herein made to teach anesthetists how to produce spinal anesthesia by injecting novocaine (neocaine) solutions into the subarachnoid space, *as each anesthetist already is convinced of the superiority of his own technique and its adaptability to his own particular problems.* It is merely wished to point out that the addition of small amounts of buffered nupercaine will prolong the anesthesia easily up to two and one-half hours and, at the same time, it not only permits a reduction in the dosage of novocaine used but, also, it will give a *vastly superior anesthesia for prolonged surgery;* and, it is believed, that this is the first publication of a series of combined novocaine-nupercaine anesthesia.

The doses of nupercaine advised are well within the toxic limits of the drug, and the collapse and other untoward features mentioned by Ziegner[25] are not observed. It is reasonable to think that some of the unsatisfactory results reported in the foreign journals are due to *too large doses* and, when the smaller doses were used, to *not waiting long enough* to get sufficient anesthesia. The combined method allows the surgeon to begin at once under the novocaine effect, and gives plenty of time for the nupercaine anesthesia to become established for the later stages of the prolonged surgical procedures. Whether or not potentiation occurs, is for future experience to disclose.

In this combined spinal anesthesia, it readily can be observed when the novocaine action has become dissipated. For example, suppose you have induced this anesthesia with the maximum height on the nipple line after twenty minutes. At the end of an hour you will notice that the anesthesia has receded about $1\frac{1}{2}$ to 2 in., say to midway between the nipples and the ensiform. This shows that the novocaine has worn off. However, the anesthesia will remain at that latter point for a total of two and a half to three hours.

Certain other favorable factors with combined novocaine-nupercaine anesthesia are observed: Properly given, there is less nausea or tendency to nausea on the table; there is much less postoperative discomfort and distress, hence less narcotics are needed in the first twenty-four hours; there is a lessened incidence of postoperative catheterization, quite a noticeable difference. Many other advantages are apparent, too many to cite in a single monograph, and correspondence is invited from those interested in clearing questionable points. It is hoped that other anesthetists will give this method a trial to prove or disprove its value.

At present, nupercaine is supplied in a 2 c.c. ampule of buffered solution containing 10 mg. of nupercaine, a 1–200 mixture. It would be particularly advantageous, *for the long anesthesias,* if some manufacturer would provide an ampule with the proper novocaine-nupercaine proportions mixed and ready for use. Such ampule should not be over 2 c.c. in size, as a pertinent factor in the successful use of this combination is the injection of a small bulk of solution. The specific gravity of the solution should be raised, by the addition of saline, glucose, or some inert chemical, to approximately 1.025 or 1.030. The solution in the ampule must be boilable, or autoclavable at a pressure of 15 lb. and a Fahrenheit temperature of 250°.

There is no question that this combination could be used for shorter anesthesias by reducing the nupercaine factor and for

still longer anesthesias by increasing it; however, safety and everything else considered, a certain and positive anesthesia lasting up to two and a half to three hours is deemed sufficient and ideal.

This thesis is based on 140 cases, the method being used only in those surgeries which gave indications of being prolonged, other types of spinal anesthesia being used for the shorter operations. One hundred of these cases were administered by the writer and 40 are included from a report from Baker,[1] to whom this technique was communicated so that he could run a parallel series as an independent check and for an opinion. He writes: "I like nupercaine so far as my experience goes and am delighted to have it added to what we already have."

When starting the use of a new drug or combination, it always is well to review the previous work and publications; and, since nupercaine (percaine) was developed in Basle, it is only natural that one must look to the journals of France, Germany, Switzerland, and England for the earliest reports on the use of the drug under discussion. These manuscripts have been appearing for the past year and a half, and the volume of literature upon the subject indeed is impressive. Walker[24] discusses the use of percaine in surface anesthesia, particularly as applied in urology. Wachtel[23] has written on the use of percaine in gynecology and obstetrics. Ritter[17] has reported a long and impressive series of cases of all kinds, operated upon, with percaine as a local anesthetic. Hofer[8] states: "Looking back on the remarkable efficacy and on the peculiar chemical structure of percaine, we feel that in time cocaine and its chemical relatives may become things of the past." Uhlman[22] presents the difficulties met with during the production of this agent and discusses its toxicity, along with the effects on isolated vessels of the rabbit's ear and on the cornea of the rabbit's eye.

In addition to these men, cases have been reported by Heckenbach,[6] Rosenstein,[19] and Klestadt.[11]

In the face of such an imposing array of literature, the question might be asked why the author advises and uses nupercaine in combination rather than alone. The question is quite proper, and the answer is at once easy and reasonable. First, it is the writer's opinion and experience that the elements of control are much more easily understood and applied with the combination, rather than in comparison with nupercaine used alone, as at present on the market. *The combination will be safer in average hands.* Second, nupercaine is an exceedingly powerful drug (Uhlman[22] estimates it to be ten times as strong as cocaine and forty times as strong as novocaine); hence, for the present, it should be used in *very minimum dosages.* Thirdly, with the doses advocated herein, the nupercaine anesthesia is slow in becoming established; therefore the novocaine is added for the early and quick effect. Lastly, with the 5 mg. to $7\frac{1}{2}$ mg. addition, a safe, rational, and *controllable* anesthesia may be produced which, in 100 per cent of the cases, lasts over two hours. This is all any surgeon reasonably could ask.

In conclusion, no apology is offered for publishing results from such a small number of cases. As to the extent of the block and the duration of the anesthesia, each case responded exactly as was theorized beforehand. Each case was checked, double checked, and studied until, in the aggregate, they have more value than many hundreds casually observed. Six months have elapsed since the combination first was used, and no untoward effects have presented in any single case, operatively or since. It is believed that combined novocaine-nupercaine spinal anesthesia *for prolonged surgery* will find a very definite place in the armamentarium of the spinal anesthetist. The anesthetist who knows only one method of general anesthesia must make every patient conform to that type of

surgical narcosis; knowledge of how to use other additional forms gives him greater flexibility of choice and adaptation. So in spinal anesthesia. To know only one of the many ways of inducing spinal anesthesia, *restricts* and *limits* the spinal anesthetist. He should have knowledge of, and experi-ence in, spinocaine, gravocaine, novocaine, neocaine, and now, also, nupercaine or combined novocaine-nupercaine. Then, and then only, is he capable of rendering, to both patient and surgeon, the fullest and the most beneficent service. And this, no less, ever should be his aim.

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SPINAL ANESTHESIA

A PRACTICAL DISCUSSION*

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MY observations and conclusions with spinal anesthesia are based on a careful study of 250 personally administered cases, the great majority being cases especially indicating this form of anesthesia.

To those who continue to look upon spinal anesthesia with askance, and who still feel that spinal anesthesia is too dangerous for use, I wish to relate my own personal experience among a group of skeptical medical and surgical associates. When I began the use of spinal anesthesia in January, 1928, it was because its use was a necessity, the case being a fractured femur in a person with advanced prostatic obstruction, requiring an open operation. I ran up against a rather firm opposition to its use in our hospital. It was made a subject of discussion and the question came up as to whether I would be allowed to use it there. At the present time, however, the attitude is changed to the extent that I have been requested to give spinal anesthesia for every surgical chief on the hospital staff, and on the genito-urinary service it is the routine anesthesia. From an almost absolute condemnation of the procedure, it has come to be very openly accepted.

I do not believe that the operative procedure should be made to fit any particular type of anesthesia but that the anesthetic should be chosen to fit the particular operation and patient at hand. Ether and the other gaseous anesthetics still have their field, although it is the general feeling that ether is far from being an ideal anesthetic and the general tendency is to use it less and less frequently. This is evidenced by the vast amount of experimentation and research now being done on anesthesia. Attention is being directed to the gaseous types of anesthesia, to the barbituric derivatives for intravenous and oral anesthesia, to the alcohols for rectal anesthesia, and to local anesthesia.[1] All of these are being used to the utter neglect of ether as an anesthetic agent. This work is being done with one thing as its objective and that is the finding of an ideal anesthetic method. Spinal anesthesia is one of these methods and one would believe that, according to some men, it is the most ideal method known today. I agree that it is the most ideal method now in use for certain operations and for certain individuals, but I do not believe in its routine use.

The two most popular techniques are the Labat and the Pitkin. With the Labat method neocaine crystals are used and spinal fluid is used as the solvent. This is prepared with the patient's own spinal fluid and after the neocaine crystals are dissolved the fluid is reinjected. With the Pitkin method novocaine is dissolved in physiologic salt solution to which starch paste, alcohol, and strychnine are added, and purchased under the trade-name of spinocaine, in ampoules ready for use. I use the Pitkin method and am well satisfied with it.

Much has been written about the use of small needles, with a 45° bevel. Personally, I prefer the Babcock needle of 20 G. size and 3 in. long because of the ease with which the spinal fluid can be withdrawn and reinjected. The argument advanced in favor of the small needle is that the gap made in the dura is so small that very little leakage takes place, and this helps to prevent headaches. I have had but one patient who complained of headache, and that occurred in an obstetrical case in which I had used the heavy 40 per cent novocaine solution and not the light 10 per cent novocaine (spinocaine) solution.

Therefore, from my experience, the size of the needle has nothing to do with headache production.

Fig. 1. Relations of spinal cord to vertebrae. Note that the spinal cord ends at lower border of first lumbar vertebra. Arrow points to most frequently selected interspace. Puncture should not be done higher than first lumbar interspace for fear of direct trauma to cord. Adult relationship only portrayed.

little more than 1 c.c. reinjected until the entire expansion has been obtained. For perineal and vaginal work only 2 c.c. of
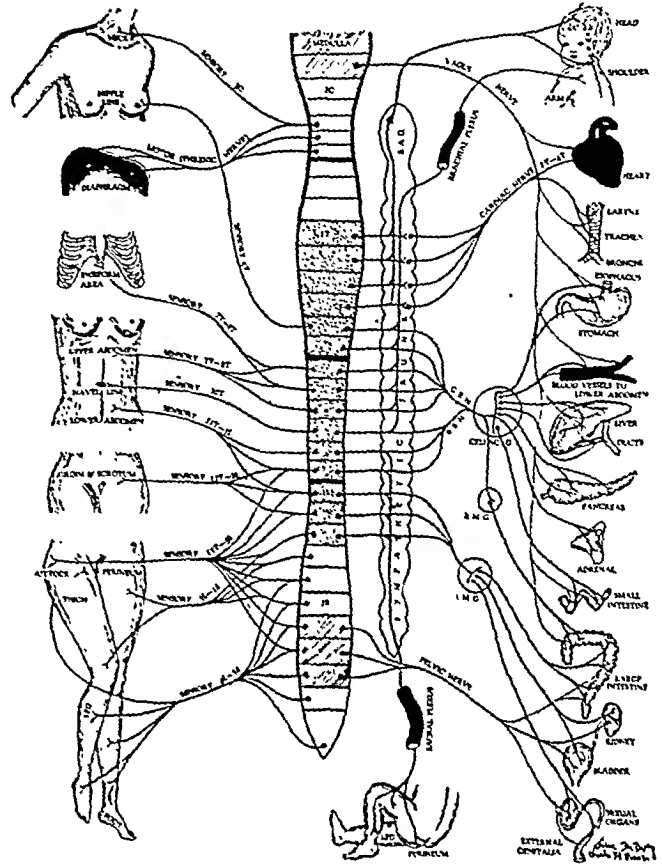
Fig. 2. Illustrating (1) the sensory spinal nerve distribution, (2) the sympathetic trunk, its connections with the spinal cord via rami communicantes, its visceral and vascular distribution, (3) the vagus nerve. Note especially the component segments that go to form the phrenic nerve.

The technique has been adequately and frequently described and a repetition here is unnecessary. Pitkin's contribution on this is especially clear and thorough. The following is the routine I have developed for establishing the height of anesthesia. After lumbar puncture has been successfully performed, a 4 c.c. syringe (not 3 c.c. as originally advised by Pitkin), containing the determined amount of spinocaine solution (usually 2 c.c.) is adapted to the spinal puncture needle and the expansion of the anesthetic solution accomplished by withdrawing 2 c.c. of spinal fluid and then injecting to the 1 c.c. mark, that is, 3 c.c. of the mixture are injected with the first stroke of the plunger. After that, 1 c.c. of spinal fluid is withdrawn each time and a

spinal fluid are admixed; for operations on the lower extremities, Scarpa's triangle, and lower abdomen 6 c.c. of spinal fluid are admixed; for operations above the umbilicus, and below the transverse nipple line, 8 c.c. of spinal fluid are admixed. Never do we advise the admixture with more than 8 c.c. of spinal fluid. See the accompanying diagram for tegmentary nerve supply.

When the anesthetic mixture has been injected turn the patient on his back and lower the head of the table at once, and wait for the anesthesia to establish itself. Usually the anesthesia sets in very rapidly, but occasionally I have had to wait for about ten minutes. The anesthesia usually lasts about one and a half hours. If longer anesthesia is required 3 c.c. or even 4 c.c.

of spinocaine can be used with safety. A proportionately less amount of spinal fluid is then admixed.

If the patient complains of nausea, have him take a few deep breaths and administer 10 per cent carbon-dioxide in oxygen

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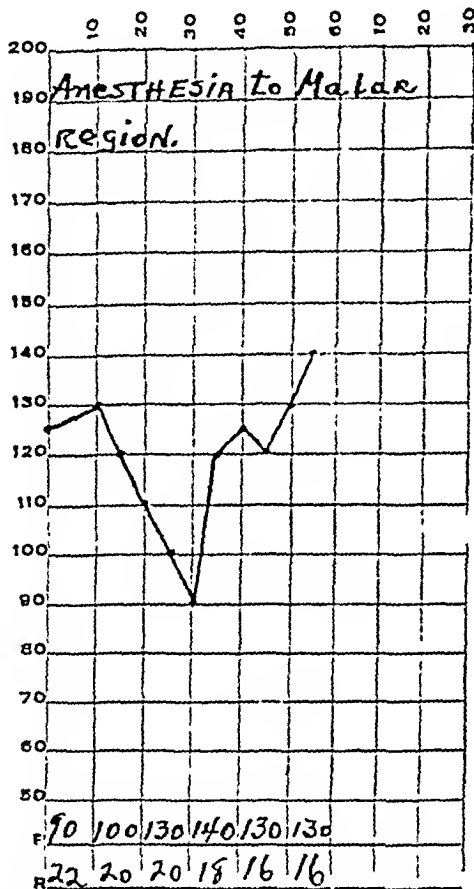
FIG. 3. Relationship of systolic blood pressure, pulse rate, and respiratory rate in case of high spinal anesthesia.

J.S. - 8-8-30
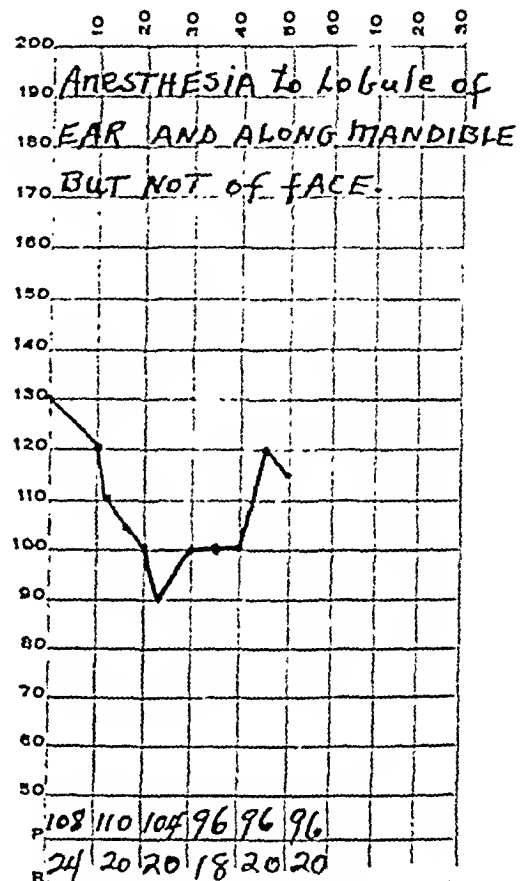
FIG. 4. Relationship of systolic blood pressure, pulse rate, and respiratory rate in another case of high anesthesia.

Conduct during the Anesthesia: Apply the sphygmomanometer cuff and take blood pressure every five minutes for the first half hour, and then as one desires after that period. I insist that blood pressure readings be done because they give the first clue to anything going wrong. I have never had occasion to feel alarmed about the patient's condition, even though there was a very marked drop in pressure. I have had the systolic pressure in a few cases drop from 120 or 130 to 50 mm. or 60 mm. and still the patient's condition was good. I always give 1 c.c. adrenalin when the pressure drops to 80 or below.

with the regular gas machine, and apply cold towels to the face and neck. Do not worry if he vomits. If the patient becomes nervous, $\frac{1}{6}$ grain morphia will quiet him in a few minutes.

If the patient is quiet and not nauseated, he may be allowed to take a few sips of water during the course of the operation, unless the operation is a gastric one or is being done for intestinal obstruction. At no time should the head of the patient be raised after anesthesia has set in. Remember that the safety of the method is entirely dependent upon the circulation of the brain, *and the patient must therefore be*

kept in the Trendelenburg position. Excessive Trendelenburg position is not necessary. It only makes the patient uncomfortable. Occasionally one will discover a very high anesthesia, but that is no occasion for worry. I have had 3 cases of high anesthesia. One of these had anesthesia to the hyoid bone, one to the level of the external angle of the orbits, and the other to the chin. All of these, therefore, affected the origin of the phrenic nerves (third, fourth, and fifth cervical segments), and one of them affected the lower two branches of the fifth cranial nerves (trigeminal). In 1 case the blood pressure dropped from 130 to 90 and went up to 140, and in the other case the pressure went up from 120 to 180. One case, the one in which the pulse went up to 130, showed slight signs of pallor. In all these cases the respiratory rate ranged between 16 and 24. Of course all these patients remained conscious. It appears therefore, that high anesthesia is nothing to worry about, and the theory that if the phrenic nerve roots are reached the patient will die from respiratory paralysis is exploded.

The physiology of the action of spinal anesthesia is not at the present time completely understood. Why the phrenic nerves, for instance, continue to function even though the anesthetic solution obviously is in contact with them, has not, apparently, been satisfactorily explained. Regarding the association of the height of the anesthesia and the behavior of the blood pressure, we find extreme drops with low anesthesia as well as with high anesthesia, and we also find that some cases of high anesthesia do not show a drop in the blood pressure at all. Regarding the pulse rate, we find it varies markedly and with no regular association with extent of anesthesia. In the past we were taught that very high spinal anesthesia would cause a slowing of both the heart rate and respiratory rate because the vagus nerve to the heart was not opposed in its action by the anesthetized accelerator nerve and that the respiratory rate was slowed and the excur-

sions shallower because of depression of the phrenic nerves. We now know that the heart is not slowed in its action in high anesthesia, but instead, is likely to become increased in its rate. The respiratory rate seems to be little affected at any time by spinal anesthesia, except in amplitude.

I have not been able to find a satisfactory explanation, for the phenomena of rapid pulse with high anesthesia and for a sustained blood pressure in high anesthesia. It may be that selective affinity of novocaine for purely sensory fibers of the sympathetic system is the real explanation. Certain it is that the rami communicantes contain both sensory and motor fibers. It has generally been taught that the rami communicantes are given off from the anterior roots from the first or second thoracic to the third lumbar segments, and when all these are affected by the anesthetic solution that complete vasomotor paralysis occurs, and, of course, one should expect the blood pressure to then approximate zero. However, it does not occur very often as shown in the cases of exceptionally high anesthesia already cited. It may be that preliminary injections of ephedrine have something to do with the particular paradox but this has yet to be proved. The finding of the explanation for the phenomena relating to the blood pressure will at the same time explain the pulse phenomena, or vice versa, as in both cases we are dealing with the rami communicantes fibers in their function of opposing the vagus nerve.

Cardiovascular Disease: Sufficient stress has not been laid on cardiovascular disease and spinal anesthesia. The general statement that spinal anesthesia should be used when the cardiac risk is too great for inhalation anesthesia is, obviously, too general. It is not true that spinal anesthesia is a panacea for the cardiac surgical case. It is true that most cardiovascular cases are suitable risks for spinal anesthesia. In my experience there are two chief groups that react badly under this form of anesthesia.

1. Cardiac disease associated with decompensation. When dyspnea is an accompaniment the patient cannot breathe freely unless the head and shoulders are elevated, the latter position being unsafe with spinal anesthesia, because the only cause of death from spinal anesthesia is cerebral anemia, which is prevented by the use of the Trendelenburg position. In this type of patient one can use the heavy solution and one should do so when an emergency operation below the umbilicus must be done. As a routine, the heavy solution has comparatively few advocates. I have recently used the heavy solution a few times, but I do not have the confidence in it that I have in the light solution, because I would be almost helpless if cerebral anemia should develop. For an emergency operation, however, one should not hesitate, if gas or ether is contraindicated and local infiltration or regional block anesthesia cannot be used. The latter is the best method in these cases. Stokes-Adams disease, whether active or quiescent, should especially be regarded as a contraindication except when managed as here outlined.

2. Cases of cardiovascular disease associated with a high blood pressure presenting an inordinately low diastolic pressure. I have come to fear high pulse pressure more than ordinary decompensation. The normal ratio of blood pressure factors is usually stated by the following equation:

$$P:D:S$$
$$1:2:3$$

The diastolic is normally twice the pulse pressure and the systolic three times the pulse pressure.

Example $= {}^{120}\!/_{80}$ (Recorded blood pressure).

Pulse pressure $120 - 80 = 40$.

$$\frac{P:D:S}{40:80:120}$$

When this ratio is changed materially one can expect and will get a very decided drop in the systolic pressure. If the pulse pressure equals the diastolic pressure the condition is serious, and if the pulse pressure is greater than the diastolic, then operation under spinal anesthesia should not be done.

In this connection I wish to record my experience with a patient presenting a marked change in the normal ratio. This was a case of a patient with complete urinary retention due to an hypertrophied prostate upon whom a two-stage prostatectomy was done under spinal anesthesia. The first operation was completed without any anesthetic difficulties.

The second operation was performed three months later and before the operation the pressure reading was ${}^{145}\!/_{75}$, that is $\dfrac{P:D:S}{70:75:145}$. In other words the pulse pressure was almost equal to the diastolic pressure and the systolic twice the pulse pressure. The systolic pressure immediately began to drop and at the end of fifteen minutes had reached 80 systolic. (Diastolic reading not recorded.) At this stage ½ c.c. adrenalin and ½ grain of ephedrine were given subcutaneously. Ten minutes later the systolic pressure had gone down to 60 and the diastolic was not recordable. At this stage 7 minims of adrenalin were given intravenously and almost immediately the patient complained of severe pain in his head and chest and became slightly cyanotic and the pressure was ${}^{195}\!/_{80}$, that is $\dfrac{P:D:S}{110:80:190}$. Within about five minutes the pain in his head and chest began to subside and simultaneously the pressure began to fall rapidly until within ten minutes it had again reached ${}^{60}\!/_{0}$ and I was satisfied to await further developments. Fortunately the pressure remained at that level and the end-result was satisfactory. One might criticize the treatment rendered here, and in the light of my present knowledge, justly so; but the fact remains that I did what the great majority of spinal anesthetists would have done. I do not now pay as much attention to blood pressure reductions, but I must say that I do not like such radical drops. If I feel beforehand that such will occur, I hesitate

to employ spinal anesthesia. In these cases there is a narrow margin of safety under any form of anesthesia and the choice of which to use is a hazardous one.

Cardiac irregularities, including fibrillations, and angina pectoris cases are not contraindications to the employment of spinal anesthesia, provided that these two conditions are absent.

During the time I have been using spinal anesthesia I have come to some very definite conclusions, to wit:

i. Spinal anesthesia is a method that has come to stay. It is a safe anesthetic when used in properly selected cases.

ii. It should not be given by anyone but an expert. I do not subscribe to the opinion held by some that spinal anesthesia may be administered by anyone who can do a lumbar puncture.

iii. Spinal anesthesia is an ideal anesthesia for the following conditions:

　1. Intestinal obstructions of all forms.

　2. Obstructions of the lower urinary tract: prostatic hypertrophy, stricture of the posterior urethra, subcervical nodes, etc.

　3. Urinary extravasations with toxemia.

　4. Major amputations of the lower extremities.

　5. For surgery of diabetics.

　6. For surgery below the diaphragm in patients suffering from pulmonary tuberculosis.

　7. For surgery in certain heart and kidney diseases.

　8. For those cases of acute abdominal conditions where there is a question of pneumonia.

iv. Spinal anesthesia, while not absolutely indicated, has special usefulness in the following conditions:

　1. Treatment of fractures of the lower extremities.

　2. Rectal work of all types.

　3. Perineal and vaginal operations.

　4. Intra-abdominal surgery of the female reproductive organs.

　5. Any operative procedure below the

diaphragm, requiring as much as one and one-half hours to complete. Shock is eliminated.

　6. Ruptured duodenal or gastric ulcers.

v. I do not believe that the ordinary run of operations of the upper abdomen on good risk patients can be done with a greater degree of safety under spinal anesthesia than with ether or gas-local combination. If the patient is a poor risk, because of associated damage to heart (q. v.), lungs, or kidneys, or if the patient is diabetic, the safer method is spinal anesthesia.

vi. Postoperative complications are markedly reduced. In this series there were no respiratory complications. One patient developed gastric dilation, from which recovery was rapid.

vii. The mortality rate for bad risk cases is markedly reduced. All deaths occurred as a result of the primary surgical condition. On the genitourinary service the death rate is now only 3 per cent, and the majority of the cases operated upon are prostatic cases. The deaths on this service are mostly advanced urinary extravasation cases. Only one prostatic patient died and that was due to suppurative peritonitis.

There are actually very few contraindications to the use of spinal anesthesia. They are tabulated as follows:

i. Infections, including ordinary pustule (pimple), at the site of the puncture.

ii. Very low blood pressure. One must be very cautious in its use if the systolic pressure is below 100.

iii. Septicemia cases.

iv. Concensus of opinion is that operations above the diaphragm are more safely performed under other forms of anesthesia.

v. Cardiovascular: decompensated cardiac muscle, Stokes-Adams disease, inordinately high pulse pressure (relative).

vi. Cerebrospinal:

　1. tuberculosis

2. syphilis
3. brain tumor
4. cord tumor
5. meningitis—any type
6. turbid spinal fluid.

There are many reasons why spinal anesthesia is advantageous in the groups of cases cited. These have been thoroughly dealt with in the many papers written, but there are two advantageous factors which have not been sufficiently stressed. The first one is the question of traumatic shock. Spinal anesthesia represents Crile's anoci-association to the nth degree. Because of the break in the reflex arc occasioned by anesthesia of the sensory nerve root, the impulse originating in the operative area never reaches the cord for transmission to the sensorium. Very extensive and prolonged operations can be performed without any evidence of shock. Amputations through the thigh are probably as shocking as any operation below the diaphragm, if not the most shocking. I have performed this operation twice on debilitated individuals and there was no evidence of shock in either of them; in fact, the blood pressure varied only 5 mg. in 1 case and none in the other. Hysterectomy, especially panhysterectomy, is another example of a shocking operation. I have performed 4 supravaginal hysterectomies, and one panhysterectomy under spinal anesthesia, and none of these showed any evidence of shock. It is a pleasure to know that your patient leaves the operating room in good condition. I have found it necessary at times, however, to give a little nitrous oxide by inhalation, in addition, because the patient insisted upon being put to sleep.

The other advantage which has not been sufficiently stressed or appreciated is the difference in postanesthetic nursing service. Spinal anesthesia patients are put in bed with the foot of the bed elevated, and given a couple folds of gauze and a kidney basin. They can then take care of themselves and the nurse can go about her other duties. Unless vomiting occurs, they need no care for two or three hours. In contrast to this is the ether patient, and occasionally, the nitrous oxide patient, both of whom need constant nursing care until they have regained their faculties, usually in one to six hours.

I wish to make one word of warning concerning the use of hot water bags. The patients are conscious, but a goodly part of each body is anesthetic, and it is very easy to burn these patients. When hot water bags are ordered, postoperatively, it is well to specify that they be placed in each axilla, and if the anesthetic has reached the axilla, insist that hot blankets alone be used. This is a little point but one to be heeded. I, fortunately, have not had this occur, but I have seen it and the patient does not forget it, at least for the three months or so required for healing to take place.

In conclusion, it is my conviction that every surgical service in every hospital should avail itself of this method of anesthesia. I am convinced that spinal anesthesia in bad risk cases, is certain to lower the mortality rate.

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PERNOCTON SLEEP

ITS SURGICAL USE AND THERAPEUTIC INDICATIONS*

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NO greater degree of confidence can be conceived than that which is given by the patient to the anesthetist in being brought into and kept in a painless and unconscious condition during the period of operation.

Unfortunately, all inhalation anesthetics possess disadvantages, the most serious of which is the possibility of injury to the psychic element. The induction of an inhalation anesthetic may produce a severe and often lasting psychic trauma upon the patient. The tender care of the psychic constitution is very important, especially in a person who is sick and is about to undergo an operation or to give birth to a child. We have not paid enough attention to sparing patients such psychic insults caused by careless administration of anesthesia and indifferent handling of the patient before and after surgical and obstetrical intervention. Psychic trauma will cause shock and will undoubtedly reduce the resistance of the organism. The fear instilled in many a patient immediately upon placing the anesthetic mask over his face is often greater than his fear of the operation.

As we shall deal here with a hypnotic (pernocton) or a remedy that induces sleep, it would probably not be out of place to survey briefly our meager knowledge of sleep. The present-day scientific theories, according to Freud, tend to ascribe sleep to changes in the central nervous system and usually to the cerebrum. We must not forget, however, that decerebrate birds and mammals still exhibit states which have every appearance of sleeping and waking. The modern theories fall into five general classes: viz., chemical, physiological, histological, biological, and psychological. Although any adequate treatment of these theories is, of course, impossible and out of place here, it seems desirable to review them in the briefest fashion.

Chemical Theories. Poisons are elaborated during the period of waking as the result of muscle and nerve activity. These poisons are narcotic in action and when a certain amount has accumulated, they produce drowsiness and then sleep. The toxins act directly upon the central nervous system, particularly upon the cerebrum. In sleep the poisons are no longer formed, because in this condition there is a minimum of activity. Sleep is merely the result of slow "poisoning" of the brain with a chemical. These toxins or narcotics are eliminated during the night or during sleep, and when elimination is nearly complete, awakening results. A modification of this theory holds that a lack of oxygen causes an excess of carbonic acid to accumulate in the brain, thus producing sleep. Obersteiner thought it was due to an excessive amount of lactic acid accumulated in the blood. Binz, Errero, Bouchard, and Breisacker also championed the various autotoxic theories.

Physiological Theories. Sleep is believed by many to be due to changes in the cerebral circulation. Durham, Bernard, Kussmaul, Howell, Lehmann, de Fleury, and others take the position that sleep is the result of cerebral anemia. This may be due to a dilatation of the blood vessels of the skin which causes a fall of the blood pressure in the brain. Sleep results in much the same way as syncope follows upon a lack of blood in the brain. According to these circulatory theories of sleep, cerebral congestion or an increased amount of blood in the brain produces insomnia. Other physiologists attribute sleep to cerebral congestion, mere mechanical pressure on the brain (Holland, Broadmann, Marshall

Hall, and others). Hamilton points out that this theory probably originated in a false analogy between sleep and comatose states in which a condition of cerebral congestion had been demonstrated.

Histological Theories. All nerve cells possess dendrites which touch each other and by means of which nerve currents are supposed to be transmitted from one cell to another. These currents are necessary for consciousness and when the dendrites spontaneously grow shorter so that they no longer come in contact with one another, sleep results. The neurons simply draw in their processes at night. To use Hall's phrase, "They hang up the receiver." This theory has also been utilized to explain the mechanism of certain dissociations of consciousness such as dreams, hysteria, and hypnosis. Purkinje thought that sleep is due to the "interruption of neural conductivity between the cortical matter and the rest of the cerebrum." This view was developed by Mautner, Wardemont, and Oppenheimer. Van Gieson and Sidis based their theory on the variability of different levels of neuron energy of which we shall speak again later.

Biological Theories. Claparede thinks that sleep cannot be the result of fatigue because fatigue frequently results in insomnia. Sleep is an active instinct, not the passive result of intoxication or fatigue. Its purpose is to defend the organism against fatigue. He points out that there are a great many lower forms of life that do not sleep and thinks it probable that sleep has its genesis in the periods of immobility which were originally a simulation of death. These organisms in which this occurs have been preserved by natural selection because of the accumulation of energy during these episodic periods of repose. In this connection the opinion set forth by P. G. Stiles in his book on sleep is interesting. He says in substance that to define sleep as a suspension of consciousness is not correct. If this definition were to be accepted, no animal can be said to sleep unless we grant that it is conscious at other times. All mammals and birds are assumed to sleep, probably the reptiles do, but we are not sure about the frog and the fish. Instead of asking, "Do the lower animals sleep?" We might ask, "Are they ever awake?" Is not all life below a certain level somnambulistic? Thomson has a similar idea. He thinks that sleep becomes necessary at that point in the development of the animal when it entertains a conscious purpose. Animals which have no such purpose are not overly active and do not need sleep. In them waste and repair go on in a fairly even manner, each output of energy being followed by a prompt subsidence of activity to permit recuperation. Sidis says that sleep is as much an instinct as sex or hunger. Sleep is conditioned by the monotony of peripheral stimulation, the limitation of voluntary movement and inhibition. An intermediate or hypnoidal state always separates the sleeping and waking states. His theory is based on the "Variability of different levels of neuron energy" or the changes in the "Threshold of cell energy." When the threshold rises, we fall asleep; when it falls, we awake. Thus, the immediate cause of sleep is largely sensory adaptation. When the organism becomes fatigued as the result of continued stimulation, those stimuli which have exhausted themselves or ceased to act on the organism by reason of their monotony, drop out and are replaced by new ones until the whole round of the stimuli has been gone through. Then the organism ceases to respond and falls asleep. *Organisms, therefore, fall asleep when the threshold for stimulation rises and awake when the threshold falls.*

Psychological Theories. Sleep is an inhibition, a resting of consciousness. Mental activity or consciousness is dependent upon incoming peripheral stimuli, and when these are absent, a lowering of mental activity follows and sleep results. If all peripheral stimuli are removed, sleep will naturally follow. When we attempt to

sleep, we voluntarily cut off all distracting external stimuli; we darken the room, lie quietly, stop all muscular activity, close the eyes, etc. Sleep is, in a sense, a matter of volition. Manaceine thinks that "sleep is the resting state of consciousness." Brown-Séquard, Wundt, Siemens, Forel, and Oscar Vogt ascribe sleep to an inhibition of cerebral activity. Heble thinks that "Brain activity depends on sensory activity which in its turn depends on peripheral stimulation. Consciousness is a function of sensations which in their turn are a function of external stimuli or impressions." Sleep often has been defined as a mere lack of attention, a suspension of consciousness.

The psychological explanation of sleep is in my opinion the one that best describes the mechanism of sleep. Also it is the theory which best tends itself to an explanation of the action of the hypnotic, pernocton, or the other soporifics.

Consciousness consists in a continuous association and coupling of impressions and ideas. It is, therefore, an active process by which we center our attention on a limited number of stimuli. Unconsciousness is simply the absence of such a synthesis. In an unconscious state we are unable to limit our attention to a specific number of stimuli and are aware of all stimuli impressed on us. This state may be brought about by a number of factors and conditions, viz., (a) direct depression of the nervous mechanism as in anesthesia, anemia or asphyxia; (b) fatigue; (c) involuntary inattention or inhibition. The suppression of the synthesis of ideas may be of all grades, from mental concentration through reverie, trance, the hypnotic state, and sleep to anesthetic narcosis and coma.

As will be shown later, the method of giving a pernocton hypnotic includes psychic preparation for hours, even days before the advent of the operation. This is done so that the psyche of the individual will have the fullest protection we are able to afford it. The patient is prepared by suggestion for what to expect and is told how pleasant and harmless the hypnotic is. This suggestion as a preliminary is very essential, for it induces a state of mind which is the first step to beneficial sleep. The giving of the pernocton on the day of the operation is a culmination of the process. It directly paralyzes the receptive ability, or rather the ability to synthesize ideas and impressions. This state is really sleep, similar to the natural act, for the individual is unable to concentrate on external stimuli and consequently unconsciousness is produced. The unconsciousness induced by pernocton is, however, one step beyond natural sleep, for the individual cannot be roused by ordinary stimuli. To recapitulate, the first step is to prepare the patient by suggestion, and the second step the paralyzing of the ability to synthesize ideas or impressions, a step further than that produced by natural sleep.

The responsibility of recommending any new anesthetic or hypnotic to the profession is immense. The present report is given after careful laboratory and clinical investigations and experience with over 1200 cases by the author, his colleagues and associates in the administration of the sodium salt of the secondary butyl-β-bromallyl barbituric acid (pernocton) having the formula $C_{11}H_{14}O_3N_2BrNa$. Pernocton contains all the factors making for therapeutic effectiveness and has no detrimental qualities such as undue toxicity or difficulty of management.

From the beginning of our investigations, we had in mind the two main factors mentioned previously, namely, ease of control and harmlessness on one hand and preservation of the patient's psychic constitution on the other. Because these two factors were not found in any one of the anesthetics known today, we sought for and obtained the desired results by combining pernocton with an inhalation anesthetic, preferably ether.

In large doses, in human beings, pernocton used alone will have the effect of a complete anesthetic, but *its isolated use*

for this purpose in such large doses is dangerous and should never be attempted. Large doses act harmfully on the vasomotor and the respiratory centers, causing respiratory failure and a fall in the blood pressure. Small and medium doses induce a reduction in the frequency of respiration but at the same time cause such a decided deepening of the respirations that the respiratory cycle does not suffer but is rather improved by a greater ventilation of the lungs. It is our custom to give a small dose of pernocton as an induction hypnotic followed by ether, and the anesthesia produced is ideal. The patient is put to sleep about twenty minutes before he is transferred to the operation room. The product is given in accordance with specific instructions which shall be enumerated later. With this combination anesthetic, somatic sensibilities are to a great extent eliminated, and the psychical sensations eliminated entirely. *Complete anesthesia with pernocton is never attempted.* It should be remembered that pernocton is neither a narcotic nor an anesthetic, but merely a hypnotic. The determination of the proper dose depends upon the weight and psychic condition of the patient. As a rule 1 c.c. of the 10 per cent solution of pernocton per 12.5 kg. of body weight will be sufficient to put the patient into a deep sleep in from one to two minutes. If the patient is mentally and physically prepared, it is never necessary to use the full dose. The subjective action of this drug on the patient is remarkable. The systematic psychic influence on the patient plays the most important part in the success of a smooth anesthesia without motor excitations. The desired psychic influence upon the patient is cultivated more now than ever before. The patient is prepared before he enters the hospital and especially before and during the administration of the drug. The mental impressions continue upon awakening. The staff of the hospitals should be clearly informed of the action and benefit of pernocton and understand the necessity of a quiet and encouraging

suggestive influence upon the patient before and after the operation. In some hospitals the work of the surgeons and anesthetists is made extremely difficult on account of prejudice of the attending staff toward a new method of anesthesia. The consequence is an unfavorable influence upon the patient resulting in restlessness and exaltation.

Examinations too painful to the patient to be carried out without anesthetics and minor surgical operations can be made under the hypnotic influence of pernocton. The drug has been used in this series in cases of general surgery, in operations upon the thyroid, stomach, gall bladder, appendix, kidney, prostate, tonsils, bone, and in the presence of icterus, diabetes, cachexia, and in aged persons as well as in young persons of twelve years of age and over. The drug has been used in gynecology; also in performing the operations of hysterectomy, myomectomy, ectopic pregnancy, salpingostomatomy, vesicovaginal, fistula repair, Sturmdorf operation, levator myorrhaphy, hemorrhoidectomy. It has been used in obstetrics, both in normal and abnormal deliveries and in the presence of eclampsia. In over 1200 cases, there was not a single fatality, and in only 4 cases was there found an excessive amount of excitability which was believed to have been due to an improper technique; namely, too rapid injection of the drug. The time taken to inject the required quantity of solution is of the utmost importance. It is obvious that a quantity of a chemical substance calculated on the bodily weight should be incorporated into the general circulation very slowly, especially if the solution is hypertonic and of a P_H 9.8, and hence very alkaline. The P_H of the blood is 7.4 and if the solution is introduced into the blood stream slowly, the buffer action of the blood brings the blood alkalinity back to normal very rapidly. But if a quick, overwhelming concentration of the blood stream with a highly concentrated alkaline solution takes place, a fall of the blood pressure and

faulty respiration will be noticed and motor excitations will follow. Although the tissues absorb the solution very rapidly and the P_H of the blood is reestablished very quickly and the patient becomes normal again in two to five minutes, it is very desirable and easy to avoid such disturbances. However, the pulse does not change in frequency, the pupils react to light, and the peripheral reflexes are not influenced. In experiments on animals, death from overdosage always results from failure of respiration. Even when breathing has already been suspended by fatal doses, the blood pressure and the heart beat are still maintained for a short time.

The method for the intravenous injection of pernocton is as follows:

. 1. Pernocton is a hypnotic to be used intravenously. If used intravenously in the proper dose, instant sleep is produced with the elimination of all sensation.

2. Its principal use is for induction and support of an inhalation anesthetic and it serves to avoid all psychical disturbances of the patient and a great saving of ether or any other anesthetic which might be used.

3. The average dose need not be more than 1 c.c. to 12½ kg. of body weight.

4. The intravenous injection should be made as slowly as possible. It is best to inject 1 c.c. every one to two minutes, using a watch for control.

5. If, during the injection, the patient goes to sleep, the injection should be stopped even if the full dose has not been given.

6. In fifteen to twenty minutes after the injection, a small amount of ether may be given to the patient by inhalation. In many operations and in obstetrics other anesthetics, even ether, will be found unnecessary.

7. It is better not to use any morphine or any other opium preparation before pernocton is injected. However, morphine may be given for postoperative pain if necessary. Atropine is always given in doses of from 0.4 to 0.6 mg. (grain ⅟₁₅₀ to grain ⅟₁₀₀) one half-hour before the operation.

8. The normal sleep after the operation, which may last from two to five hours, reduces postoperative pain to a minimum.

9. In obstetrics: in primipara, the injection should be done after the external os is about three fingers dilated. In multipara, it may be injected after dilation of two fingers. In obstetrical cases where we have a protracted labor of many hours, a second pernocton injection may be given if necessary, but a second injection should not be more than 2 c.c.

Although the technique for the intravenous administration is laid down, it should not be used schematically according to body weight. It is very seldom that as much as 1 c.c. to 12.5 kg. body weight is found necessary. If the injection is given slowly from one to two minutes per cubic centimeter, it is found that one-half to three-fourths of the computed dose is required to induce perfect sleep and that is all that is desired of the drug. By all means, the computed dose of 1 c.c. to 12.5 kg. body weight should never be exceeded. The maximum dose is estimated in order to protect the patient from a careless anesthesia in which the limits of dosage are overstepped and the patient's life endangered. If the solution is properly administered, no failure will be encountered. The patient usually loses all sensation in from one to two minutes. He has no anxiety or fear, dizziness or other abnormal sensations. He does not even feel tired or have foreboding of sleep. The consciousness is in a moment obliterated. While going to sleep, there is no sign of excitation if the solution is slowly injected. The most careful observer will not be able to detect any change in the patient except that he does not answer questions put to him. One is, therefore, able to put to sleep a patient suffering from Basedow's disease without his knowledge of the intended operation. The patient gives the impression of a quiet and peaceful sleeper. The length of sleep varies with the individual, the amount given, and the mode of administration; the average being from two to five hours if not

shortened by hypodermatic injection of caffeine sodium salicylate, or by inhalations of oxygen or carbon dioxide gas, given immediately after the operations.

The patient awakens after two to five hours as from a natural sleep. He does not remember having taken ether or any other inhalation anesthetic. He very often asks upon awakening when the operation will take place. The sedative action of pernocton prevents anoci-association, nausea, and vomiting. There is no headache, and no matter how large a quantity of ether was administered or how long the operation lasts; there is no excessive desire for water. The uropoietic system remains normal, probably because no morphine is used before the administration of pernocton. The incidence of respiratory complications appears to be lessened in our series since using pernocton as an induction hypnotic. Asphyxia and aspiration pneumonia have not appeared. This is probably due to the relatively small amount of ether used in conjunction with pernocton. From 60 per cent to 80 per cent of ether has been saved. The anesthetist has been able to discard the use of mouth gags, tongue forceps and other paraphernalia commonly used during anesthesia. Ether action and elimination are prompter because the psychic and reflex defenses are removed and the ventilation of the lungs remains in a relatively physiological state or is increased. The sleep after the operation is beneficial to the patient because he usually does not feel the first traumatic pain. However, if the patient should need morphine after the operation, it may be given. The patient is ordinarily allowed to drink as soon as he is able to swallow. The second day the patient usually asks for food. If ether is used following pernocton, the patient very often has an exciting cough for the first few inhalations of ether. This takes place also if we change from nitrous oxide to ether anesthetic. This passes off rapidly with the abolition of the reflexes. It has never been our experience to have a patient awaken under this combined anes-

thetic during the operation no matter how small the quantity of ether used. The excitation from the combined ether-pernocton anesthesia is never as great as with ether alone. Excitations take place even in spinal anesthesia. There are many cases of severe psychoses reported after spinal anesthesia. Hellendall[1] reports a very remarkable case of psychosis with hallucinations following spinal anesthesia with novocaine and adrenalin which he used for the operation and for ileus in the same case. This woman became so bad that she had to be transferred to the insane asylum where she eventually died. Postoperative accidents and complications in the form of collapse, pneumonias, lung abscess, ileus, and vomiting were never experienced by us following the use of pernocton. The urine which is always checked up soon after the operation remains as normal as before the operation, showing no albumin, sugar or cast; but there is a positive reaction to acetone and diacetic acid for from one to four days. Hemolysis which takes place in every general anesthetic cannot be demonstrated after pernocton-ether anesthesia.

The question of how long pernocton remains in the system is answered by the exhaustive work of Boedecker and Ludwig and Fretwurst, Halberkann and Reiche. They found that the secondary butyl-β-bromallyl barbituric acid is decomposed rapidly and almost completely in the circulation. The barbituric acids of pernocton are broken down to butyl acetonyl barbituric acids which may be transferred to malonylureic acetic acid. Boedecker and Ludwig gave these compounds to animals but could not produce any hypnotic effect; hence the observation that the action of pernocton passes off quickly (two to five hours).

The clinical observations of my co-workers, Drs. Irene L. Sparling and Harold I. Sparling are that the quick decomposition of pernocton is disadvantageous in ob-

[1] This case is quoted by Hellendall in the *Zentralb. f. Gynaek.*, Sept., 1930.

TABLE I

Operation	No. of Cases
Appendectomy	216
Cholecystectomy	47
Gastroenterestomy	19
Nephrectomy	7
Prostatectomy	9
Thyroidectomy (Graves disease)	7
Thyroidectomy	31
Tonsillectomy	148
Salpingectomy (ectopic pregnancies)	9
Hemorrhoidectomy	43
Hysterectomy	26
Levator myorrhaphy	160
Salpingectomy	36
Salpingostomatomy	63
Sturmdorf operation	208
Vesicovaginal fistula	5
Deliveries	155
Eclampsia	6
Osteomylitis	5
	1200

stetrics because the metabolic rate of the woman in labor is so much increased that the hypnotic is broken down much quicker and therefore does not very often last long enough to complete the labor. The last stage has to be supplemented with a small quantity of ether in a few cases.

Halberkann and Reiche state that this quick decomposition is due to the bromallyl group which favors oxidation in the organism. Our observation is that the hypnotic effect ceases at the point of decomposition.

CONCLUSIONS

1. Pernocton, in chemical structure, combines the advantages necessary in anesthesia in the possession of a long side chain and a halogen replacement of the hydrogen atom without suffering the disadvantages of similar compounds; i.e., insolubility, toxicity, etc.

2. Pernocton produces unconsciousness closely related psychologically to natural sleep, with the added benefit of rendering the subject impervious to external stimuli which disturb natural sleep.

3. As a hypnotic, pernocton administration coupled with psychological preparation of the patient, completely eliminates the psychic traumata which are such detrimental factors in inhalation anesthetics.

CHART

Urea

Malonyl

Malonyl Urea — Barbituric Acid

Diethyl Malonyl Urea — Veronal

Iso Amyl Ethyl Malonyl Urea — Amytal

Iso Allyl Propyl Malonyl Urea — Hypnotic constituent of Allonal

Calcium Ethyl iso-Propyl Malonyl Urea — Ipral

N. Butyl Ethyl Malonyl Urea — Neonal

Phenyl Ethyl Malonyl Urea — Luminal

Sec. Butyl-β-Bromallyl Malonyl Urea — Pernocton
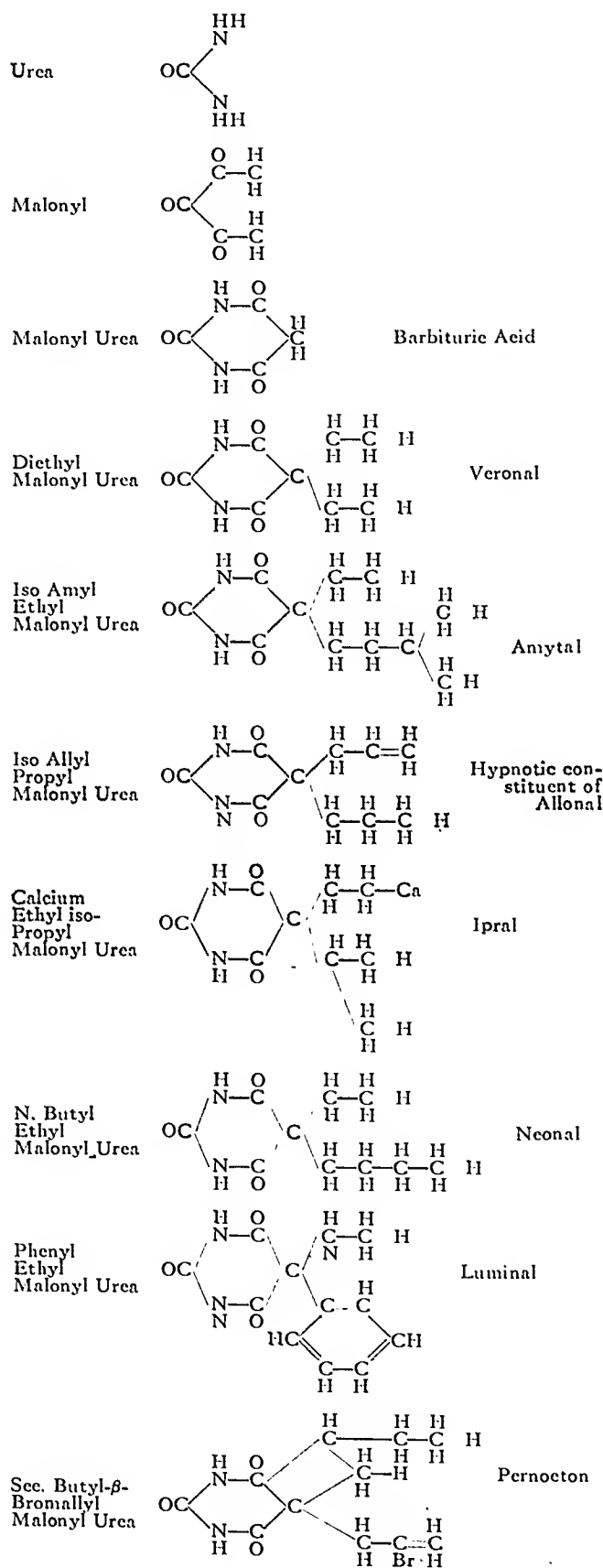
4. Pernocton should be administered in a dosage relative to the body weight, and the directions for technique should be carefully studied. The dosage may be dimin-

ished if the patient is psychologically prepared.

5. Pernocton should never be administered in doses great enough to abolish the reflexes. In major operations, it should be used as an extreme hypnotic for induction, and combined with a small amount of ether.

6. Painful examinations, minor surgical operations, and many obstetrical procedures may be performed in the pernocton sleep.

7. The author presents 1200 cases in which pernocton has been used without a single fatality, conditions of extreme excitability being present in only 4 cases, as evidence of its beneficent effectivity.

8. Pernocton sleep is recommended as a long sought anesthesia for minor surgery and induction hypnotic for major surgery, since it combines efficacy and the production of benign psychic conditions with an elimination of detrimental toxicity and psychological disturbance.

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to employ spinal anesthesia. In these cases there is a narrow margin of safety under any form of anesthesia and the choice of which to use is a hazardous one.

Cardiac irregularities, including fibrillations, and angina pectoris cases are not contraindications to the employment of spinal anesthesia, provided that these two conditions are absent.

During the time I have been using spinal anesthesia I have come to some very definite conclusions, to wit:

I. Spinal anesthesia is a method that has come to stay. It is a safe anesthetic when used in properly selected cases.

II. It should not be given by anyone but an expert. I do not subscribe to the opinion held by some that spinal anesthesia may be administered by anyone who can do a lumbar puncture.

III. Spinal anesthesia is an ideal anesthesia for the following conditions:
1. Intestinal obstructions of all forms.
2. Obstructions of the lower urinary tract: prostatic hypertrophy, stricture of the posterior urethra, subcervical nodes, etc.
3. Urinary extravasations with toxemia.
4. Major amputations of the lower extremities.
5. For surgery of diabetics.
6. For surgery below the diaphragm in patients suffering from pulmonary tuberculosis.
7. For surgery in certain heart and kidney diseases.
8. For those cases of acute abdominal conditions where there is a question of pneumonia.

IV. Spinal anesthesia, while not absolutely indicated, has special usefulness in the following conditions:
1. Treatment of fractures of the lower extremities.
2. Rectal work of all types.
3. Perineal and vaginal operations.
4. Intra-abdominal surgery of the female reproductive organs.
5. Any operative procedure below the diaphragm, requiring as much as one and one-half hours to complete. Shock is eliminated.
6. Ruptured duodenal or gastric ulcers.

V. I do not believe that the ordinary run of operations of the upper abdomen on good risk patients can be done with a greater degree of safety under spinal anesthesia than with ether or gas-local combination. If the patient is a poor risk, because of associated damage to heart (q. v.), lungs, or kidneys, or if the patient is diabetic, the safer method is spinal anesthesia.

VI. Postoperative complications are markedly reduced. In this series there were no respiratory complications. One patient developed gastric dilation, from which recovery was rapid.

VII. The mortality rate for bad risk cases is markedly reduced. All deaths occurred as a result of the primary surgical condition. On the genitourinary service the death rate is now only 3 per cent, and the majority of the cases operated upon are prostatic cases. The deaths on this service are mostly advanced urinary extravasation cases. Only one prostatic patient died and that was due to suppurative peritonitis.

There are actually very few contraindications to the use of spinal anesthesia. They are tabulated as follows:

I. Infections, including ordinary pustule (pimple), at the site of the puncture.
II. Very low blood pressure. One must be very cautious in its use if the systolic pressure is below 100.
III. Septicemia cases.
IV. Concensus of opinion is that operations above the diaphragm are more safely performed under other forms of anesthesia.
V. Cardiovascular: decompensated cardiac muscle, Stokes-Adams disease, inordinately high pulse pressure (relative)
VI. Cerebrospinal:
1. tuberculosis

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THERAPEUTIC PARAVERTEBRAL ALCOHOL BLOCK

OBSERVATIONS OF ITS EFFECT FOLLOWING ITS USE IN ANGINA, ASTHMA, AND RAYNAUD'S DISEASE*

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ALCOHOL block of the rami communicantes is an anatomical section. It was first employed by Swetlow in 1924, and his report in 1929 of 41 cases following its successful use established it as the major therapeutic measure for the relief of angina pectoris.

White and others have reported its results in the relief of suffering in a wide variety of conditions. The alleviation of pain was the primary concept in its application. The rami communicantes in this pathway has not alone to do with pain but also with circulation, secretion, and the action of all of the glands in the area controlled by its several segments.

The interference of the action of the sympatheticotonic by blocking causes a lessened vasoconstriction on all of the blood vessels within the blocked area. The resulting increase in the blood current as a consequence of larger vessels causes greater physiological activity and increased nutritional changes therefrom.

In the use of paravertebral alcohol block for the relief of angina, anhidrosis was observed, and along with it a difference in the temperature and an alteration in the sensation of the skin in the blocked zone. It is rational to infer that a similar influence on the viscera within the blocked area must of necessity follow. It appeared from this observation and conclusion that asthma might be relieved by paravertebral alcohol block, however contrary this conclusion was to the accepted idea of the association of asthma with vagotonia. The inhibition or destruction of the action of the sympatheticotonic in the lung and bronchial zones should augment the tendency to asthma and manifestly make it worse when present, on account of the resulting increase of action of the vagotonic. This,

however, did not occur when the first to the fifth dorsal rami communicantes were blocked bilaterally in the asthmatic. There was a disappearance of râles, and the asthma stopped. After this therapeutic measure was used in several cases of asthma, a unilateral block was done on a profound asthmatic, with the result of disappearance of bronchial râles on the blocked side and their persistence on the other side. Chronic asthmatics in whom all other measures of treatment had failed were the ones used in this therapeutic test. The results were successful uniformly in the relief of asthma continuously, one year being the longest time elapsing since the first case was blocked.

In the cases of angina, increased exercise did not result in cardiac distress, cyanosis, or circulatory failure after blocking as it did before. Something had happened in these patients besides the mere relief of pain. Electrocardiograms were then taken three months after the blocking, and compared with the electrocardiograms taken before the block; these showed a definite decrease in the defects in the several leads, and in some instances a return of the impulses to within normal range. These observations apparently proved that increased nutrition had been given the heart muscle as the result of an increased vascularity following the block.

In the case of Raynaud's disease, an improvement in the circulation of the extremities was most evident, and along with it a disappearance of erythromelalgia.

The work of Jonnesco was the first to establish surgical sympathectomy and ganglionectomy on a sound basis as a measure for the relief of pain. It has been shown by many observers both from surgical sympathetic nerve section and from
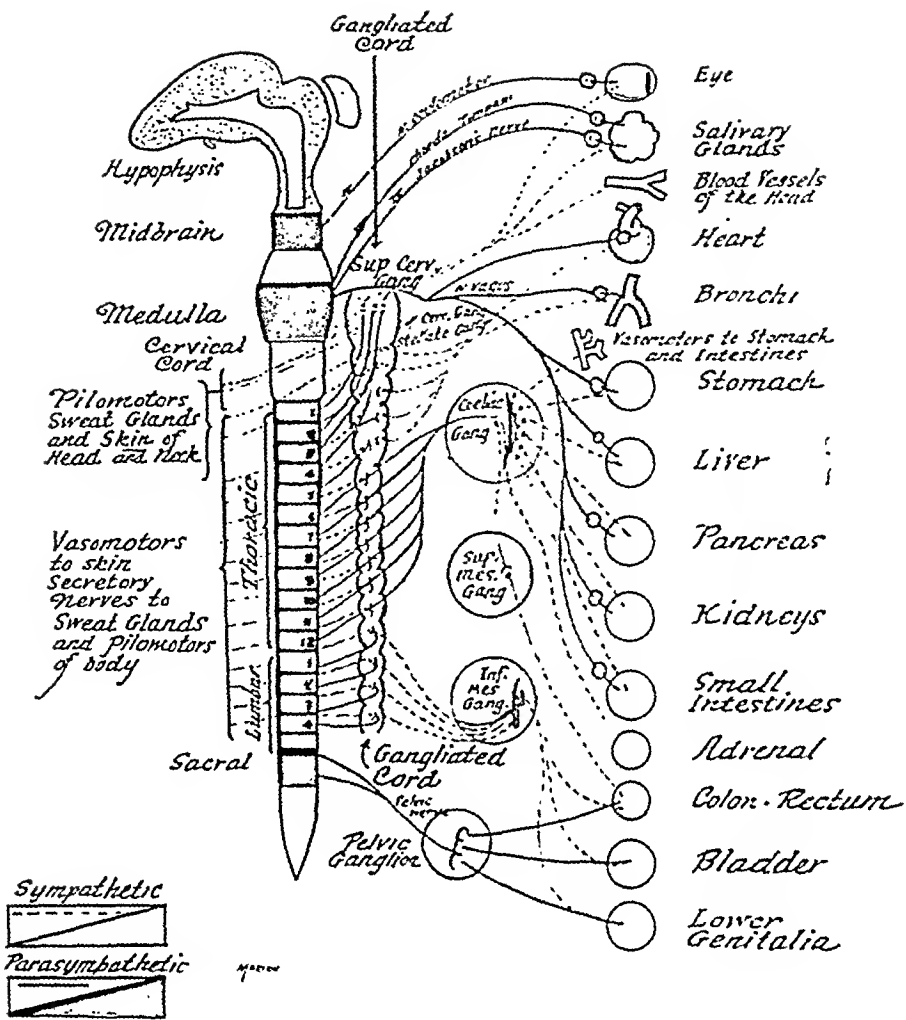
FIG. 1. Schematic illustration of distribution of two components of vegetative nervous system, showing its division into sympathetic and parasympathetic and their branches to various organs.

Thoracicolumbar portion of cord, which gives origin to sympathetic nervous system, is represented in red. Portions of the midbrain and medulla, and sacral segments of cord, which give origin to parasympathetic system, are represented in blue. Peripheral nerves belonging to parasympathetics, are shown as solid blue lines, while those belonging to sympathetic system are shown as red lines. This chart shows double innervation of structures of head, heart, and entire enteral system, and likewise indicates single innervation for blood vessels, pilomotor muscles and sweat glands of body. (Modified from Meyer and Gottlieb.)
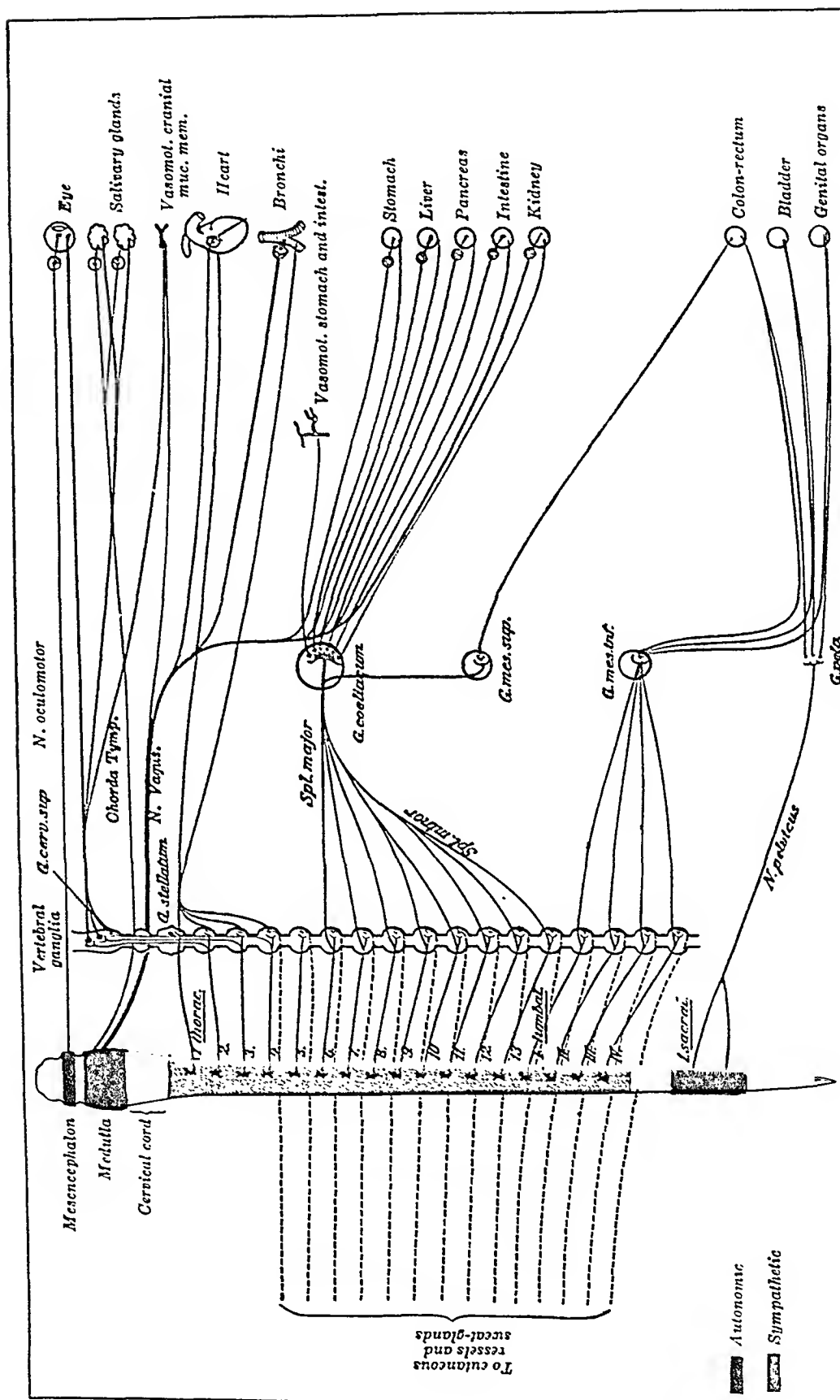
FIG. 2. (From Meyer and Gottlieb. Pharmacology. Lippincott.)

alcohol blocking of the rami that peripheral vasodilation followed; it appears now and we hope to show that visceral vasodilation
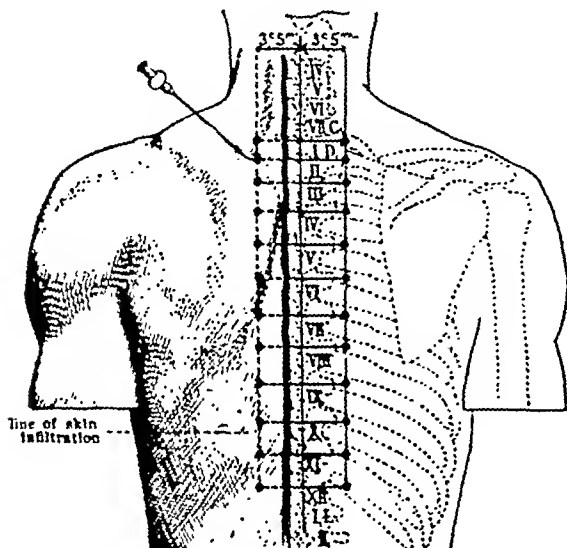
FIG. 3. Dorsal paravertebral anesthesia. (Pauchet.) Skin is infiltrated with a band 1 cm. wide at a distance of 35 mm. from the median line. The operator introduces the needle through this band and feels his way. Black dots show where needle should enter to reach the rib, somewhat laterally to costovertebral articulation. When needle has come in contact with rib, it turns about its inferior border and proceeds toward a point 0.5 cm. further forward and inward to reach sympathetic anastomosis. It should be noted that lower angle of scapula corresponds to spinous process of seventh dorsal and spine of scapula to third dorsal.

is an additional physiological basis for its use.

In all of the cases observed there was a disappearance of cachexia and a restoration of general health and well being out of proportion to that which could be anticipated or expected from the mere relief of paroxysmal pain.

Apparently, there is a coincidental influence on the chemical and electrolytic action of perhaps all of the body cells following the effect of segmental block on the sympatheticotonic nervous system. A close association between the action of the vegetative nervous system and of the chemical and electrolytic functions of the body is generally recognized, and when one of these three is upset in its action the other two are correspondingly affected.

The connection of the vertebral sympathetic with the spinal cord is loosely segmental. Fibers spreading widely below and above the segment to which the nerve belongs make possible a complexity of reflex arcs which are the basis of the physiological activity of the system. The wide diversity and variety of the action of this great reflex arc system is poorly understood, as but few of the impulses pass over into the threshold of consciousness. The vegetative nervous system presides over the function of the respiratory, circulatory, alimentary, reproductive system, all non-striped muscular structures, and the ductless glands through the visceral, sensory receptors. There is no consciousness, as a rule, of the functions of all of these. There are at times vague and general sensory impressions, and these from forceful or prolonged stimuli may be transformed into a consciousness either of discomfort or visceral pain, representing in effect disordered or diseased conditions of the viscera.

The action of every gland, blood vessel, hollow muscular organ, and viscera of the body is controlled by the vegetative nervous system. On the sustained equilibrium of the antithetic action of the vagotonic and the sympatheticotonic systems depends the sum total of health, both physical and mental. This is the balance of potential stressed by Crile, which results in the acid and alkali equilibrium of the body, any disturbance of which produces many varying pathological states. Normally functioning without consciousness and independent of volition, there is nevertheless a definite influence from psychic stimuli. Their action is stimulated by pleasurable and inhibited by unhappy emotions. These reactions to environmental forces create impulses traversing the paths of the vegetative nervous system and are transmitted to each neurone successively by the stimuli of adjacent neurones.

The neurone should not be confused with the reflex arc. The one is an anatomical, the other a physiological unit of the nervous

system. The arcs function physiologically through sensory receptors, afferent conductors, and efferent adjustors conveying outward impulses to influence the activity of muscles and secretory cells. The result of normal activity is to increase tissue change.

The interrelationship of the sympathetic nervous system with the endocrine and electrochemical functions has been shown by Kraus and Zondek. The irritation of any one will produce a reaction in the other two. Compensatory action of different body systems is known to be an important factor in correcting the defects and disorders of any one or more of the systems. The employment of extrinsic or intrinsic stimuli to activate the vegetative nervous system may profoundly influence visceral, secretory, motor, and trophic functions.

It is reasonable to infer that correlary reflex arcs are activated by the block of one or more segments of the rami communicantes occupying the pathway of direct impulses. The rational application of these stimuli to influence or control electrochemical actions and endocrine secretions as well as to relieve pain has far-reaching possibilities of benefit and relief through the use of paravertebral block. The factors which underlie all of man's actions, his intellectual expressions, as well as his disorders of functions and disease, are the chemical and electrolytic actions of the body cells and endocrine secretions. Segmental block activates them. The work of Head, Crile, Langley, McKenzie, Hygier, Gaskell, Pottenger, Swetlow and others, is of absorbing interest and attractiveness; such researches appeal especially to minds that are looking into the origin, cause, and expressions of life.

In the surgical use of block anesthesia, experience and observation have elaborated and clarified the work of Head and others in establishing and outlining visceral and surface zones controlled by the several segments of the rami communicantes.

Because of its freedom from danger and fatality, segmental alcohol block should largely replace surgical sympathectomy on account of the high mortality of the latter.

The segments of the rami communicantes
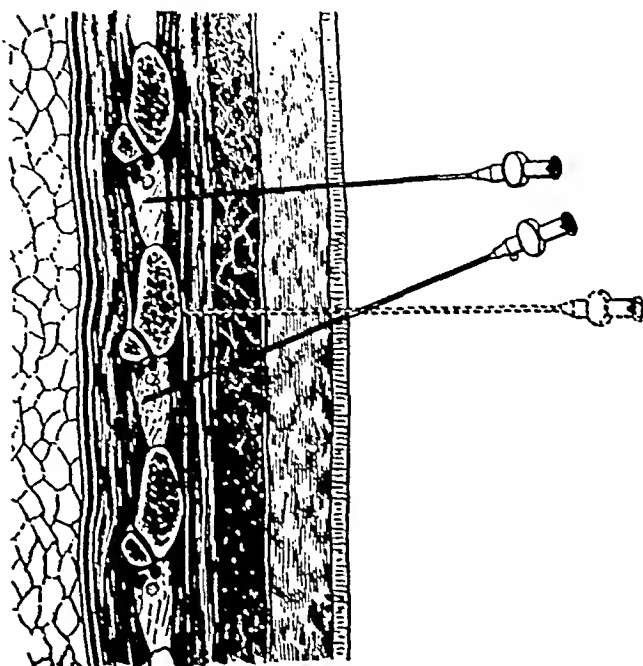
Fig. 4. Intercostal or paravertebral dorsal anesthesia. (Pauchet.) First needle is directly in the intercostal space and in the vicinity of the nerve. Second (dotted line) has at first come in contact with rib, but has then been given an oblique direction downward and has reached vicinity of nerve.

in the pathway of visceral pain are as follows:

First to fifth dorsal inclusive........Thoracic viscera, notably heart and lungs.

Sixth to ninth dorsal inclusive....... { Liver, Stomach, Pancreas, Spleen

Tenth to twelfth dorsal inclusive .... { Small intestine, Kidney

The following table will give the viscera influenced by certain segments blocked:

Esophagus	D-5: D-6
Stomach	D-7: D-8
Gall bladder	D-10 (right)
Small intestine	D-9: D-10
Kidneys	D-12: L-1
Appendix	L-1: L-2 (right)
Ascending aorta	D-1: D-2 (right)
Angina pectoris	D-1: D-2 (left)
Lung and pleura	D-1: D-4
Upper quadrants	D-12
Arm and fingers	D-1: D-2
Burning in feet	L-1

Technique:[4] A preliminary hypodermic of morphine ¼ of a grain, atropine 1/150 of a grain, and hyoscine 1/300 of a grain is given thirty minutes to one hour before

blocking to avoid shock and to relieve pain. A 19-gauge needle, 8 cm. in length, connected with a 10 or 20 c.c. Luer syringe
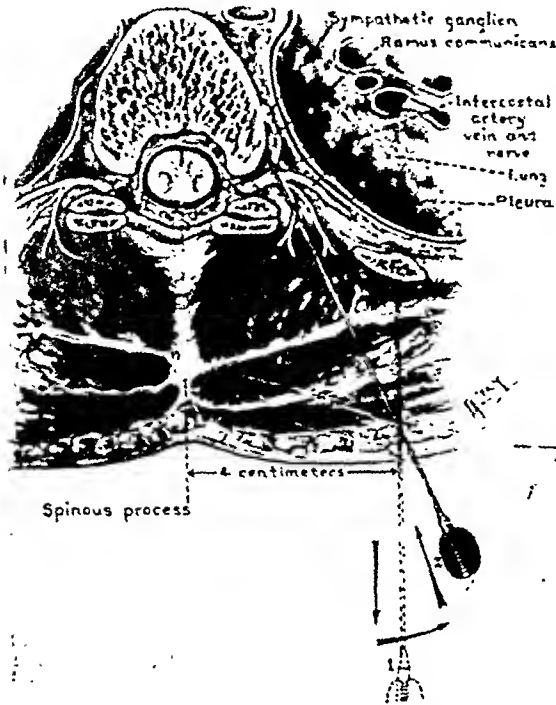
FIG. 5. Paravertebral dorsal block. Technique No. 2: Needle 1 takes contact with rib, is partially withdrawn, swung to position 2, and advanced toward spine in a direction making an angle of about 25 degrees with sagittal plane of body.

filled with ¼ of 1 per cent apothesine solution is inserted 3½ cm. from the spinous process as outline in Fig. 4, and as the needle is introduced, the solution is injected, which tends to avoid injury or puncture of the small blood vessels until the point impinges against the transverse process or the costovertebral articulation. It is then slightly withdrawn and tilted downward passing underneath the process or rib for a distance of ½ cm., with an inclination slightly inward where it should touch the rami. A sensation of pain in the surface of the body corresponding to this zone indicates that the rami has been reached. Then 5 c.c. of ¼ of 1 per cent apothesine solution are injected, the syringe disconnected from the needle which is left in position for five minutes or more and until such other segments as are to be blocked are similarly

injected. The local effect of the anesthetic will have been sufficient in this length of time to permit the injection of 5 c.c. of absolute alcohol into the area for the purpose of a permanent block. With the injection of the alcohol, there is a recurrence of pain in the zones involved more intense than when first elicited by the insertion of the needle and the local anesthetic. The anginal cases complain of a reproduction of pains in their entirety, such as are felt in the anginal attacks, and when these have been obtained the efficiency of the method is assured. The severity of the pain is coincident with the injection of the alcohol, and in intensity it persists for ten or fifteen minutes, following which there are painful sensations in the skin, which last, gradually lessening, for approximately a week. Almost immediately, there is noticed an absence of perspiration and dryness in the skin zone influenced by the block; there is also an attending sense of heat or warmth both subjective and objective.

Without eliciting the painful sensations described, one should be very doubtful of the effectiveness of the blocking, as it is highly probable that the area containing the rami communicantes has not been invaded. The usual confinement to bed after blocking is one day. It is remarkable how early even the patients who are the most serious cases get out of bed on their feet, and the rapidity with which they recover their strength and resume their vocation is always gratifying.

Impressions: For the relief of pain, especially in inoperable conditions, paravertebral alcohol block is most valuable.

In the vascular disturbances of the lower extremities, especially of the type culminating in gangrene, such as Raynaud's and Berger's disease, it has been established as a valuable therapeutic procedure.

In asthma after a year's observation of several cases, it has afforded consistent freedom from asthmatic attacks following its use in every instance.

The change in the secretion of the skin (anhidrosis), the disappearance of bronchial râles in the asthmatic, definitely indi-

cate a change in the secretion of the viscera as well as the skin within the blocked zone.

The evidence of improved circulation in the heart muscle following its use in angina is borne out both by the electrocardiographic tracings and the improvement in the general health of the individuals treated.

There is a corollary or complementary effect following the blocking of one or more segments of the rami communicantes on other glands and structures.

Insufficient observation, research and time have been devoted to these changes and they are at present poorly understood. Further research is merited in determining as nearly as possible what actually occurs in the physiology of the secretory organs within the blocked zone, and the effect of that change on the vital processes of the body as a whole, as the result of the different areas blocked.

It is probable that we are on the threshold of controlling metabolic processes in certain areas as the result of the influence of blocking the corresponding rami communicantes.

It is unquestionably certain that we can inhibit some secretions by the use of alcohol block of the rami controlling the innervation of certain glands or organs.

Since anacidity of the stomach is desired in the treatment of gastric ulcer, it should be possible to produce such a condition by paravertebral block.

It appears from the results already obtained, that a wider range of application of this therapeutic measure than for the control of spasm, pain, and areas of defective circulation is merited.

If the various secretions of the body are controllable by the use of alcohol block of the rami or ganglion of the vegetative nervous system as it is at present, to a degree, by drugs or surgery, then we are approaching the power to balance the potential, and establish an equilibrium between the acid and alkali on which depends normal physiological function.

One of the most outstanding results of blocking in the cases we have observed is in the cachectic states, so powerful an influence on general metabolism has been produced that in practically every instance there has been a disappearance of the cachexia, especially noteworthy in restoration of healthy color, frequently ruddy, to a previously pale and swarthy skin.

An extension of the application of alcohol block in modifying and controlling secretions of the viscera is doubtless the next step.

As a diagnostic measure, and especially as an indicator for paravertebral permanent block with alcohol, paravertebral anesthetic block with novocaine, or apothesine to the second lumbar vertebra and spinal anesthesia below from the second lumbar has distinct value.

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X-RAY DIAGNOSIS OF DUODENAL ULCER*

PART II

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(2) THE MORE OR LESS TRANSVERSE ENCROACHMENTS ON THE BULBAR LUMEN. According to Cole the local transverse or oblique deformities of the bulbar shadow are called bulbar defects.

These defects may be circular or unilateral, narrow or wide, sharp-edged or more rounded, single or multiple. The transverse defects are usually found at about the same level as the ulcer or niche and the oblique defects are generally pointed more or less directly towards the niche. *The defects are often more obvious than the niches themselves and are therefore of fairly great importance for the detection of these; but they are not necessary components in an ulcer deformity and are not in themselves pathognomonic for ulcer (Figs. 37, 38).

The defects may occur anywhere on the bulbar circumference, most commonly, however, and deepest, on its major curvature (see Figs. 35, 49, 52); defects of smaller size may also be seen on the pyloric outline of the bulb.

The bulbar defects may be due to a variety of causes. At first they were considered with few exceptions due to organic changes such as infiltrative processes in the region of the ulcer, abundant production of thick cicatrized connective tissue the callous masses of which protrude into the lumen, shrunken cicatricial bands in the wall, or to periduodenal adhesions. Unexpectedly in many cases no organic cause of the defect, even of deep nature, was revealed at operations, whereupon a condition of spastic contraction was assumed (Carman, Åkerlund and others). Nor can there be any doubt that many such defects, particularly those of a rounded

shape are entirely or in part due to some abnormal local contraction in the muscular coats of the bulb. On laparotomy without general anesthesia immediately after the abdomen is opened, the pursing contraction in the musculature of the duodenal wall has in several such cases been directly observed; it was further noticed that the existing contraction gradually yielded to the operative manipulations. In the same way it may be seen during fluoroscopy how a defect well marked at first may after a few moments' palpation become quite obliterated. In such cases it would seem that a spastic factor was undoubtedly present. More recent roentgen-anatomical studies of the mucous membrane of the digestive tract by Forssell, Berg and others have shown that functional, transitory changes of circulatory and contractile nature in the bulbar mucous membrane itself play a part, hitherto rather overlooked, in the production of defects, even of larger sizes. It has already been recognized that the smaller basal and juxtapyloric defects are occasioned by the local contractions and folding of the mucous membrane;[1] at the present time it is considered that a local state of contraction of the mucous membrane with subsequent formation of folds and thick edematous swelling resulting in cushion-like formations in the plane of the ulcer may make up the chief basis at least of the large rounded defects which formerly were regarded as occasioned by spasm.

Roentgenologically, it is not always possible to say whether the defect in a given case is organic or functional in character. Still more difficult is it to decide whether a defect that proves to be of a functional nature is chiefly caused by

* See Figs. 21, 23, 35, 49, 50, 52.
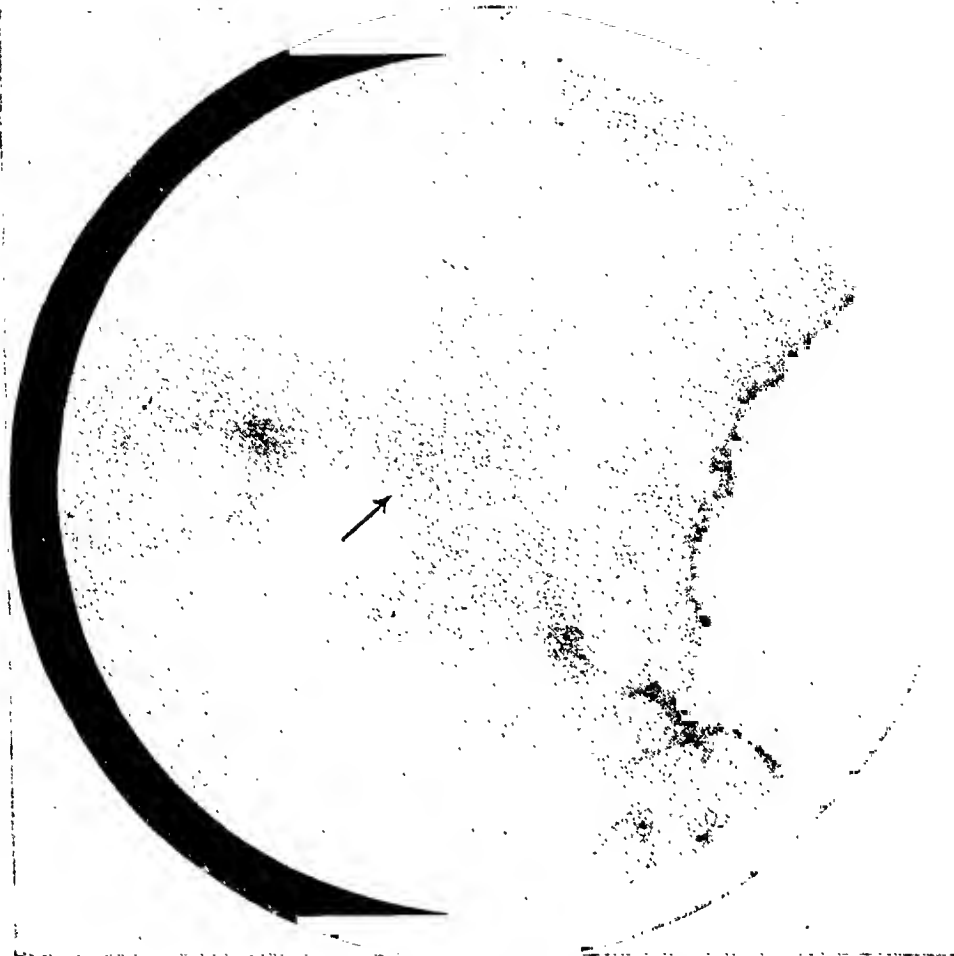
FIG. 37. Married woman, aged forty-five, with symptoms of ulcer of many years' standing. Deep defect on area of greater curvature, more shallow defect on that of lesser curvature. Closely above large defect there is a denser niche seen through bulbar shadow.

FIG. 38. Circular defect with an en-face niche level with incisura.
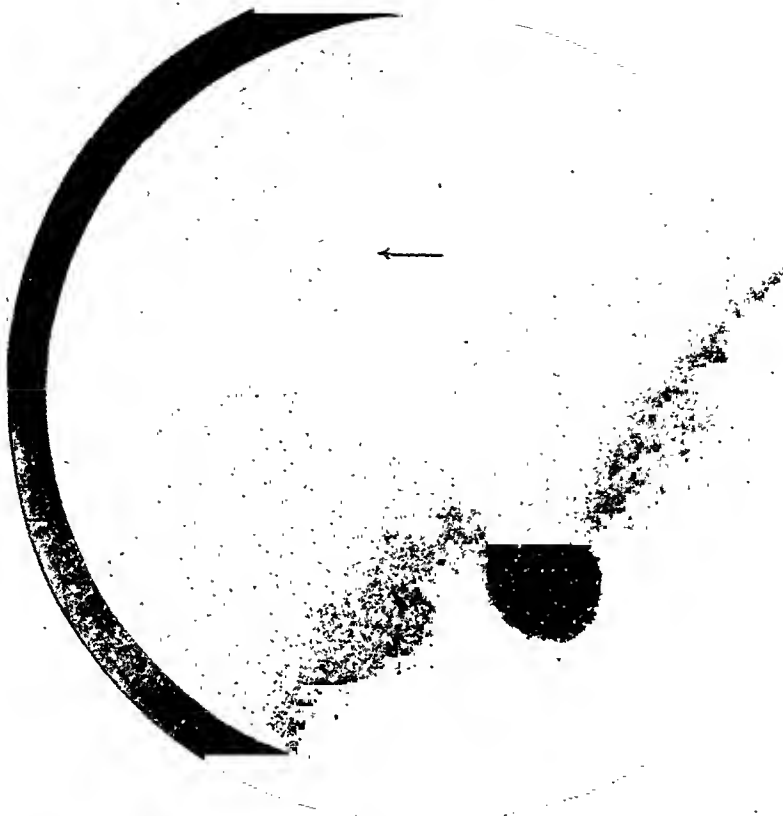
Fig. 39. Woman, aged forty-three. Periodical abdominal symptoms for the past four years; has been through two cures for ulcer. More severe symptoms during last week. Tube-shaped bulbar deformity with niche, size of a pea, on area of lesser curvature. At operation one found a large callous ulcer adherent to pancreas.
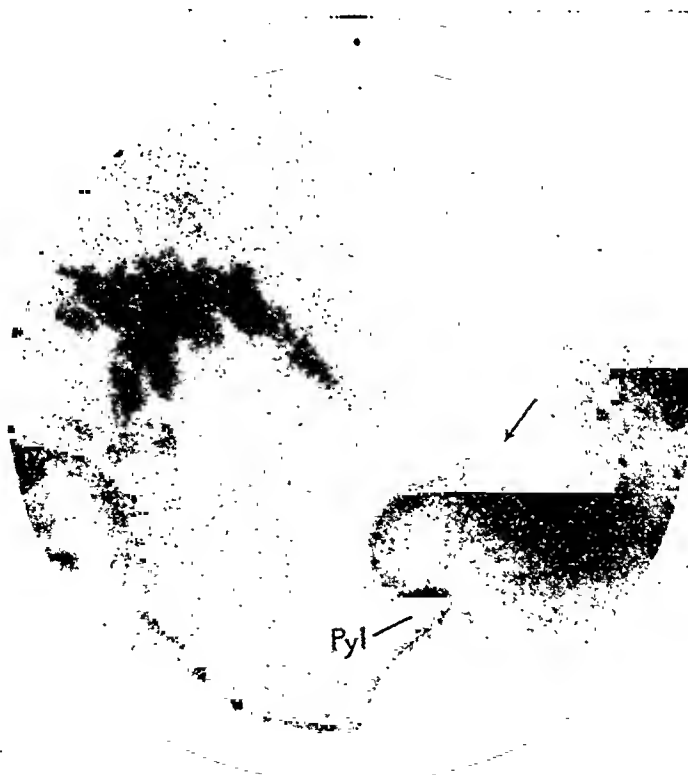
Fig. 40. Man, aged sixty-eight. Ulcer history of many years' duration. Typical retraction of lesser curvature side with small niche, level with well-marked defect; pylorus widely open. Pyloric ring is only seen on side of greater curvature.

spastic contraction of the tunica muscularis or by a transitory change in the mucous membrane; it may be that such a decision holds true in that type of deformity representing the most marked and extensive form of organic change in the bulb, namely,
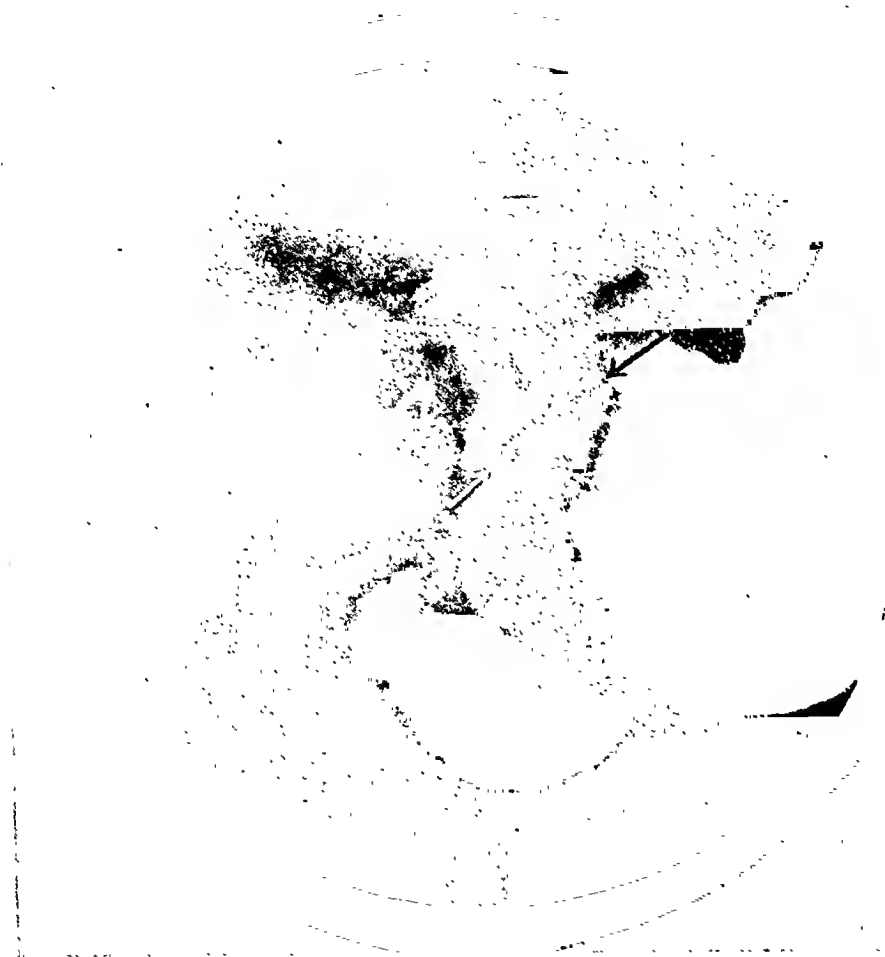
Fig. 41. Ulcer symptoms for many years. Three years ago operated on for perforated ulcer. Recurrence. Large, basal ulcer diverticulum, elongated oval niche at edge of diverticulum close to pylorus. Operative verification.

is not really of as great practical importance as the discrimination between organic and functional defects. Angular, wedge-shaped, jagged, strongly pursing defects and those situated distal to distinct pouch formations are generally caused by organic changes, particularly when unquestionable signs of shrinking (such as shortening and fixation of the bulb) are present at the same time; rounded defects and those of softer and more variable outline are more probably of functional character.

When localized to the basal part of the bulb a defect may extend as far as, and without any demonstrable limit pass over into, the pyloric ring. In such cases it may be quite impossible to definitely localize the pylorus on the roentgenogram. The same

the *tube-shaped deformity*, in which case the whole bulb may be transformed into a stiff, unyielding canal (Fig. 39).

(3) The Mainly Longitudinal Restrictions of the Bulbar Lumen. This type of deformity is generally a question of one-sided change of outline resulting in a more or less asymmetrical shape of the bulb. Within a limited area the outline loses its normal convexity, becomes flattened, taut, shortened, and, in combination with other types of deformity, perhaps even concave. It is the same process which under the name of *schneckenförmige Einrollung der kleinen Kurvatur* or "retraction" is well known as the shortening of the lesser curvature that often accompanies chronic ulcers of the stomach. Pending

FIG. 42.

FIG. 43.

FIGS. 42, 43. Man, aged thirty-six. Compression roentgenogram in first oblique projection (Fig. 42) shows an enface niche, size of a peppercorn, and a pocket-shaped ulcer diverticulum within the curvature-major area of Cole's recess. In second oblique projection (Fig. 43) both niche and ulcer diverticulum prove to belong to anterior bulbar wall.

Fig. 44. Man, aged fifty-five. Basal ulcer diverticulum on greater curvature area, proximal to large niche on curvatura minor side. Distal to this still another smaller niche on retracted lesser curvature side.
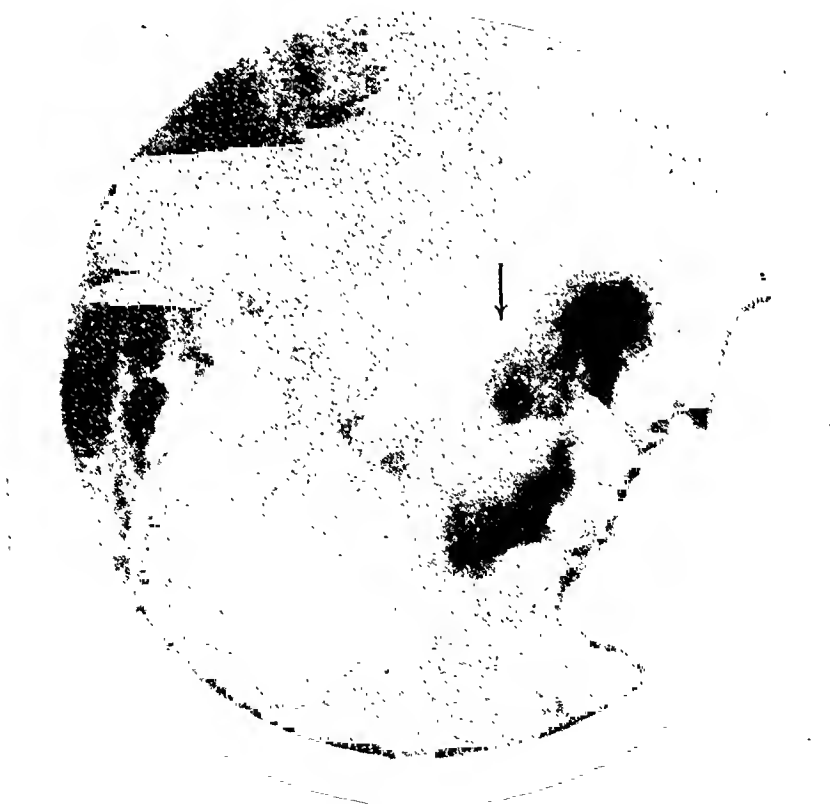
Fig. 45. Sailor, aged twenty-three. Ulcer symptoms of several years' standing. En-face niche, visible in first oblique projection on compression, is surrounded by clear ridge-like brighter zone. Operative verification.

FIG. 46. Woman, aged twenty-seven, with periodical symptoms of ulcer for several years. On compression there is seen rounded niche surrounded by ridge-shaped infiltration.

FIG. 47. Married woman, aged forty-five. Compression roentgenogram in first oblique projection shows oval en-face niche surrounded by radial folds of mucous membrane.
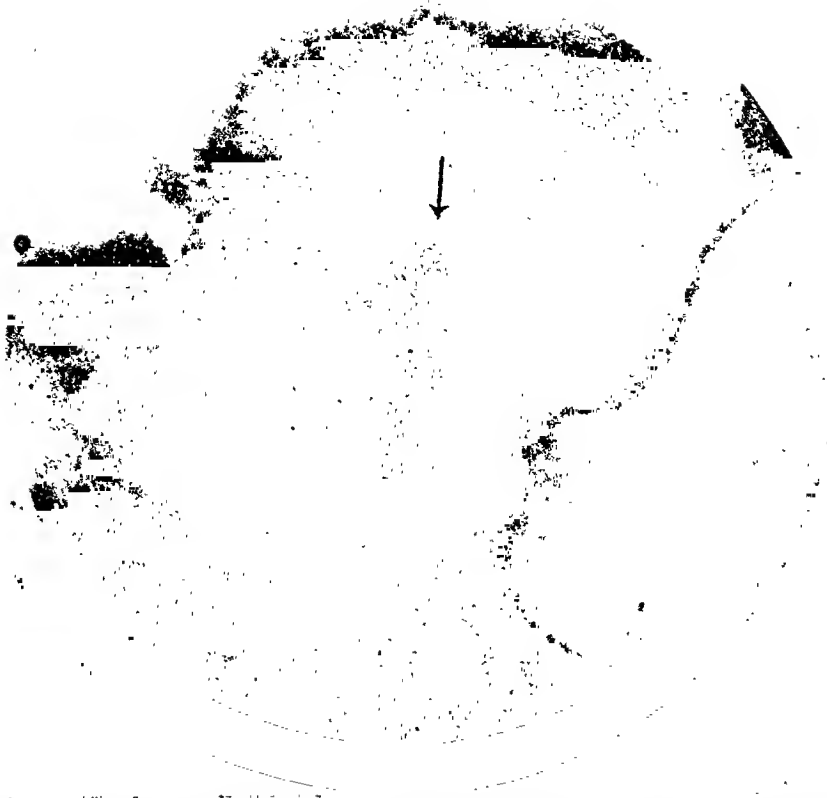
Fig. 48. Man, aged twenty-six. Periodical abdominal symptoms, lately present for month. Niche close to retracted lesser curvature side with star-shaped arrangement of folds of mucous membrane, radiating towards niche.
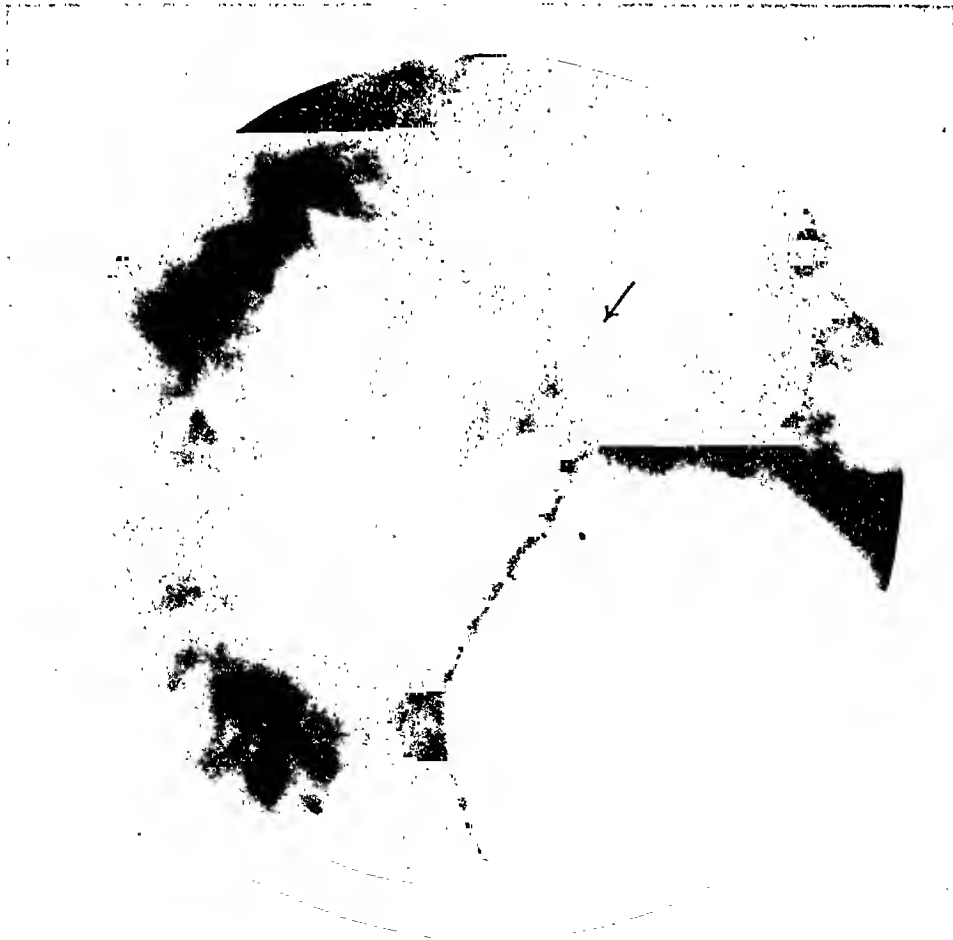
Fig. 49.

some better term the latter, shorter name "retraction" has therefore also come into use for the corresponding changes in the bar circumference corresponding to the lesser curvature the retraction is also most usual at that site.*
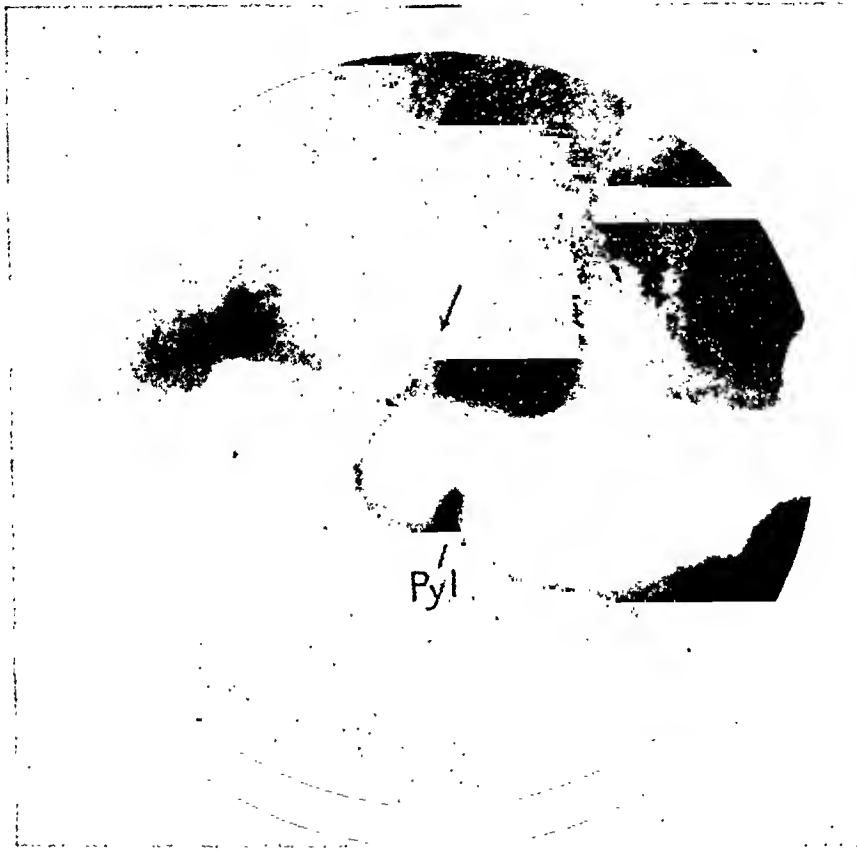
FIG. 50.

bulb. The suggested term "concavity" seems to me for several reasons less suitable, first, because a true concavity is not typical of this type of deformity in its pure form at least; secondly, because types of deformity other than the longitudinal restriction bring with them concave depressions in the bulbar lumen (both those mentioned under (2) and (5)), wherefore the name "concavity" could easily lead to confusion.

The retraction develops around that longitudinal plane of the bulb which passes through the ulcer itself. The retraction, therefore, generally becomes unilateral; but in the case of several simultaneous ulcers may develop on different sides of the bulbar circumference. Since, as has already been mentioned, the ulcers are more common within that half of the bul-

Generally the retraction has an organic origin and it is caused by shrunken fibrous bands which run longitudinally through the ulcer, as well as by callous masses that may be formed here. It seems probable that in certain cases an abnormal state of contraction in the longitudinal muscle, which is normally more strongly developed on the lesser curvature, may play some part in the production of the retraction in at least those cases where cicatricial changes are not found at operation or where a retraction rapidly abates during a course of treatment. Nowadays it is also believed that functional transitory changes in the mucous membrane of such contractile and circulatory character may give rise to similar appearances.

The retraction is not generally restricted

* Figs. 40, 44, 49, 50, 52.

to the immediate neighborhood of the ulcer but often extends along the greater part of or along the whole length of the bulb.

and the distance between pylorus and papilla Vateri become markedly reduced. Retraction plays a very important part

Fig. 51.

Figs. 49, 50, 51. Man, aged sixty-eight. Twenty-year history of ulcer symptoms, worse during three last months. Lost weight, cancer suspected. "Classical ulcer deformity of the bulb." Figure 49 (upright position) shows niche formation on retracted lesser curvature side on level with deep rounded incisura major from side. Figure 50 (prone position) is a pretty film of widely open pylorus. Figure 51 (upright position, second oblique position) shows that niche formation belongs to posterior bulbar wall.

In certain cases the change in outline may extend directly to the pylorus and may even encroach upon the last part of the stomach. In such cases Cole's recess and the pyloric ring do not become visible on that part of the circumference which is the seat of the change; the lumen of the pylorus thereby becomes eccentrically situated in relation to the base of the bulb and is often found widely open (Fig. 40).

In other cases where the retraction is mainly concerned with the upper part of the bulb and is associated with marked shortening of the bulbar wall, the upper duodenal flexure may be quite obliterated

in the ulcer deformity and may occur either in combination with the niche or without it.

(4) Pouch Formation, Saccular Dilatation, Diverticula. The sac formations often accompanying the chronic cicatricially altered duodenal ulcer (Moynihan's "pouched ulcer") are commonly called ulcer diverticula. They arise from the coaction of traction of shrinking cicatricial bands in the wall and pulsion of ingesta. Spastic contraction may also possibly contribute. In any case the ulcer diverticula may be regarded as a kind of prestenotic diverticula modified by the special

local conditions in the ulcer-containing bulb. They have nothing to do with the true so-called congenital diverticula. They

the lesser curvature and are then always smaller in size. On the roentgenogram they appear as bag-shaped dilatations of the
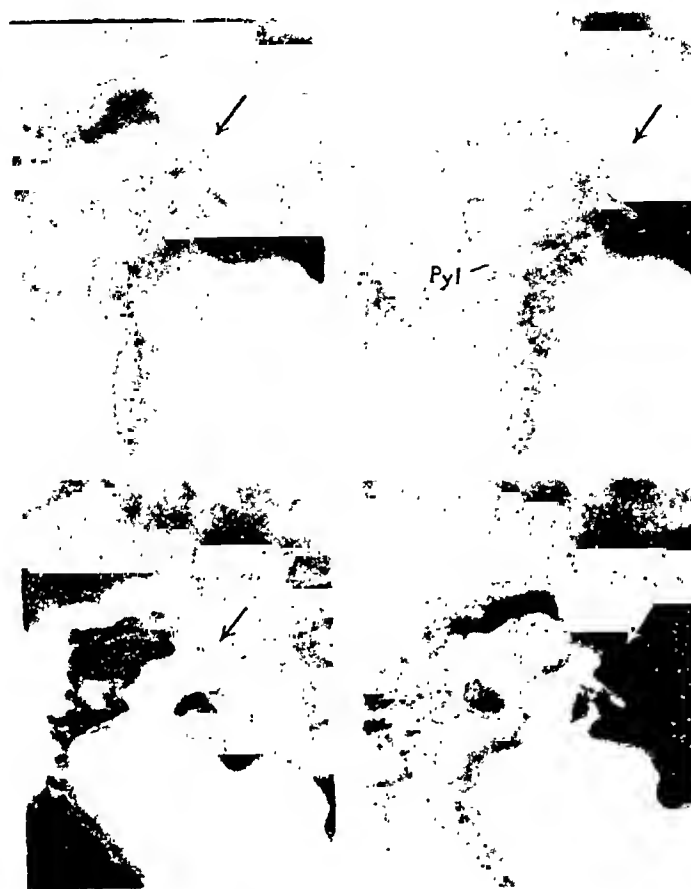
FIG. 52. Man, aged forty-one. History of ulcer for many years. Niche formation, size of pea, on retracted lesser curvature side level with deep defect from major side. Small basal prestenotic diverticulum. Operative verification.

are lined with mucous membrane and their walls are to a certain extent contractile. The niche or niches themselves are always situated at the side of such diverticula and in the center of those cicatricial bands and sulci limiting the diverticula. All transitional stages exist, from shallow pouches to purse-like circumscribed diverticular formations with a distinct neck, the latter being particularly met with in case of double or multiple ulcers. Not rarely do the ulcer diverticula occur in pairs, one on each side of the ulcer. They are generally most marked on the side of the greater curvature and on the anterior wall of the bulb; they occur more rarely on

basal parts of the bulb and present a soft and changeable outline, depending upon the degree of filling. They diminish or disappear on direct compression, in contrast to the niches which then stand out more clearly (Figs. 41–44, 52).

(5) THE ANNULAR RIDGE AND THE STAR FORMATION. Both types of deformity dealt with in this last group are of more recent date than the former types of more coarse anatomical nature and are the results of modern investigation of the finer changes in the relief of the mucous membrane as particularly developed by Forssell and Berg.

By the *annular ridge* I mean the crest-

like swelling immediately surrounding the niche formation. As has been correctly pointed out by Berg this is almost never

membrane at the edge of the ulcer and as early as 1913 Haudek suggested a tangential spasm of the muscularis mucosae at
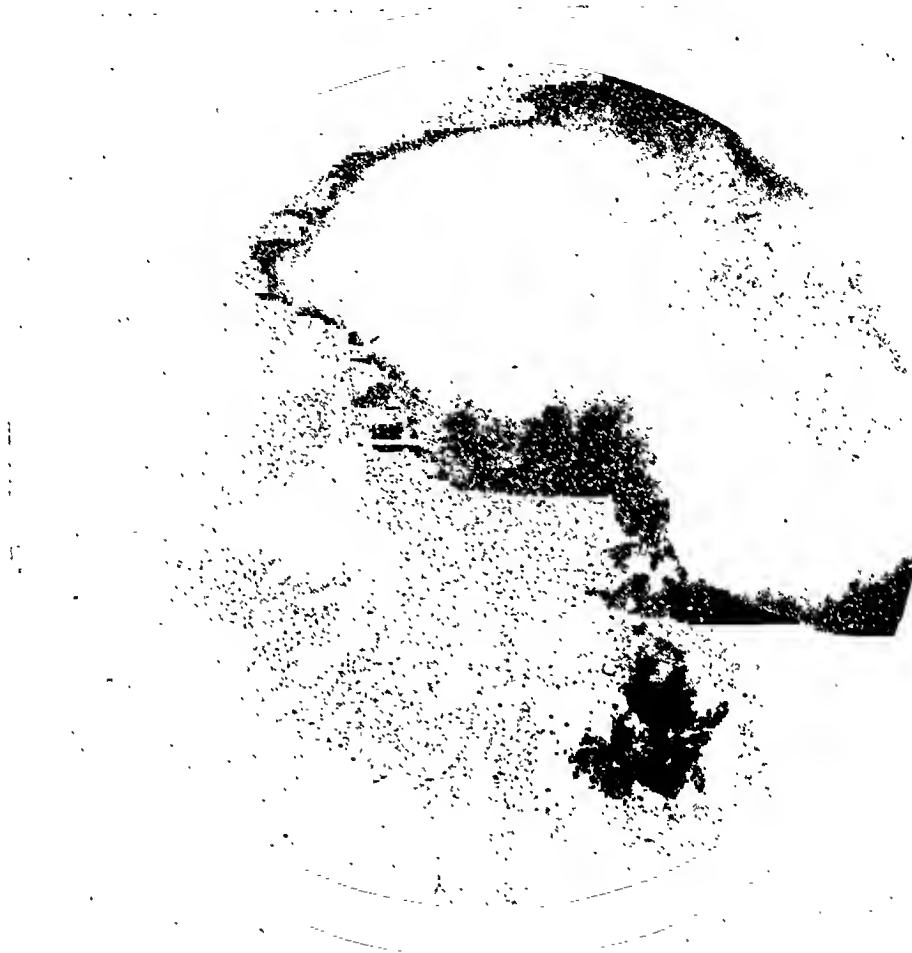
Fig. 53. Large niche formation on concave side of descending part of duodenum with alteration of contour in surroundings of niche and narrowing of duodenal lumen in plane of ulcer.

lacking, except in the case of those niches where the patients have lost a great deal of blood. "En-face" and with compression this change is seen as a circular clear zone surrounding the niche-spot itself.* In profile view in which it is more easily detected the annular ridge appears as a local concavity in the immediate surroundings of the ulcer. Its appearance is caused by a local thickened ring and swelling of the mucous membrane; circulatory (hyperemia or edema,) inflammatory, proliferative and contractile factors probably all contribute to the formation of this ridge which surrounds and deepens the niche. Therefore Hauser gave a patho-anatomical description of the proliferation of the glands of the mucous

* Figs. 9, 31, 33, 45, 46.

the edge of the gastric ulcer in explanation of the neck of the niche seen roentgenologically but which was lacking in the anatomical specimen.

The *star-like appearance in the relief* was first described in duodenal ulcers by Berg. It consists of a radiating convergence of folds of the mucous membrane towards a center where a niche-spot will frequently be clearly in evidence. The formations are fixed and not like the normal folds of the mucous membrane, changeable; they are caused by shrunken cicatricial bands, and under favorable conditions may also be found even after the ulcer has healed (Figs. 47, 48).

The different form components previously mentioned may combine into different types of ulcer deformities.

Theoretically the most important combination type is the so-called "classical" ulcer deformity of the bulb which I first described in 1919 and which represents a and segmentary incisuras are almost exclusively found in patients from more distant rural districts.

FIG. 54. Large niche formation on descending part of duodenum, penetrating into pancreas. Deep corresponding incisura.

described in 1919 and which represents a miniature picture of the well-known ulcer deformity of the stomach; niche and retraction on the lesser curvature with a corresponding deep incisura on the greater curvature (Figs. 49–52). In my first more comprehensive account of about 100 cases of duodenal ulcer, published in 1921, this type of deformity occurred completely developed in fully 50 per cent of the cases.

During the last decade it has been shown that this type in its characteristic form occurs in cases of inveterate chronic ulcers which have been long overlooked and therefore have never come under treatment. It is now therefore gradually becoming extinct, at least among the town population, a pleasing result of our diagnostic and therapeutic efforts. The fact is that at the present time this type of duodenal ulcer and also the corresponding type of gastric ulcer with colossal niches

Nowadays the commonest type seen in ulcers of somewhat older date is a niche of smaller size on the anterior or posterior bulbar wall, surrounded by an annular ridge of the mucous membrane and perhaps associated with moderate retraction and a few transverse or oblique sulci.

In recent ulcers it is not unusual to find that the bulb appears quite normal on an ordinary sagittal film without compression; but a compression film and a roentgenogram in the second oblique position show a niche or a pair of contact niches with surrounding annular ridge of the mucous membrane and perhaps a minor degree of retraction in the longitudinal plane of the ulcer.

Milder degrees of diverticular formation often take part in the deformity in case of older ulcers; the more advanced forms of diverticula are rare.

As compared with the changes in shape

the other changes present in the bulb such as *size, position, direction, displaceability, motility and sensitiveness to pressure*, play a very subordinate rôle from the diagnostic point of view and can therefore be briefly dealt with here.

Regarding variations in *size* the extremes are represented by Freud's "Phthisis bulbi" and "Megabulbus." The first name indicates an organic shrinkage and shortening of the bulb of the highest degree; the latter an enlargement of the whole bulb either with retained form, generally occasioned by pyloric insufficiency, or with an ectatic rounded form, Freud's "praller Kugelbulbus," in the case of stenotic ulcers in the upper part of the bulb. All these forms are rare.

Among more important changes should be mentioned those in the bulb regarding *position, direction* and *displaceability* in so far as these are dependent upon periduodenal adhesions or perhaps only upon a well-marked hypertonicity of the stomach. The dextroposition and the dextrofixation in cases of duodenal ulcer have long since been described (Clairmont and Haudek, 1911). A limited displaceability can be established by palpation under fluoroscopy. Berg has suggested that besides the reduced displaceability the change in position and in direction of the bulb is also indicative of retrofixation: the axis of the bulb loses its usual direction obliquely backwards and upwards and occupies a more transverse position, which is best demonstrated on turning the patient under control of the screen.

The following are the different changes in *motility* of the bulb described in ulcer cases: Eisler's "fleeting filling of the bulb," the retarded emptying of the bulb ("Dauerbulbus") and Barclay's "persistent bulbar fleck." The type of the "fleeting filling of the bulb" has rather pointedly been likened to an irritable bladder in cystitis which immediately expels even the smallest quantities of fluid entering it. In such cases, however, it is often possible during the latter stages

of the emptying to get a fairly satisfactory, and for analysis of shape sufficient, filling of the bulb with an opaque substance. Moreover, these cases are not particularly common. Neither the fleeting nor the retarded filling of the bulb is specific for ulcer but may be present in many other abdominal conditions. The "persistent bulbar fleck," the first described local sign of ulcer (Barclay, 1910), is caused by retention after complete emptying of the stomach, usually in either ulcer diverticula or Cole's normal recess and but rarely in niches. Bulbar flecks are sometimes simulated by retention in congenital duodenal diverticula in other parts of the duodenum which have been projected within the bulbar area, or by biliary or renal concretions.

Local, often punctiform *tenderness* over the bulb or niche is very common and typical in duodenal ulcer but is often entirely lacking even over quite obvious niches both acute and chronic.

Diagnosis. A careful analysis of the direct roentgenological signs of duodenal ulcer and particularly the detailed analysis of the shape of duodenal bulb, is of the greatest importance for the *diagnosis* of duodenal ulcer and for the *differential diagnosis* between this and a number of other conditions which are also associated with roentgenological local changes in the bulb.

The various direct roentgenological signs in cases of duodenal ulcer vary considerably in their diagnostic importance.

The most formidable proof is the niche. The presence of a niche, which is the commonest sign of ulcer and which has been demonstrated in about 75 per cent of my cases of definite duodenal ulcer, is, provided that it clearly fulfils the previously mentioned criteria and is constantly demonstrable, pathognomonic of ulcer and just as certain as an anatomical demonstration.

Amongst the extensive material of roentgenologically certain bulbar niches personally collected by me in the course of

the past ten years I cannot recall a single case where an undoubted roentgenological diagnosis of niche has not been confirmed, if not at the exploration of the outer aspect of the duodenal wall, yet always on examination of the resected specimen where this has been accessible. It is natural that the less experienced examiner is often prone to label as niches smaller ulcer diverticula, accidental lumps in the opaque mixture and other shadows of lesser size which happen to have been projected within the bulbar area but do not belong to it, as, for example, a small concretion in the kidney or gall bladder. This fact, however, only emphasizes the importance of a methodical technique of examination and a detailed analysis of the shape of the bulb.

In those cases, however, where the niche is lacking as a sign of an open crater-shaped ulcer, the other local roentgen-ray findings in the bulb enable us to establish the diagnosis of duodenal ulcer.

Such local signs of practical proof even without the presence of niches are:

(1) A radiating arrangement of the folds of mucous membrane of the bulb towards a central point ("star formation").

(2) The simultaneous presence of a marked retraction of the medial part of the bulb and a well pronounced local contraction from the opposite side.

(3) Prominent diverticular formation in the basal part of the bulb proximal to a contraction.

(4) Shortening of the whole bulb with perhaps an obliterated superior duodenal flexure and diminished distance between the pylorus and the papilla Vateri.

The other roentgenological findings in the bulb do not in themselves justify any diagnosis of ulcer but only a more or less pronounced suspicion of this possibility. In most of the uncertain cases a definite diagnosis may be arrived at if the examination be repeated once or twice just when the symptoms are most troublesome. If it is a question of ulcer one will sooner or later succeed in bringing out a niche that clinches the diagnosis.

With the use of this technique probably only a very small number of ulcer cases, indeed only the superficial and acute, are missed in the duodenum; proportionately many more gastric ulcers are undoubtedly overlooked in the roentgen-ray examination.

I quite agree with Berg when he says that a repeatedly negative roentgen-ray finding with this method excludes with a probability that borders on certainty a chronic, surgical ulcer and also with a fairly great probability an ulcer that requires medical treatment at the time of examination.

Differential Diagnosis. The most important conditions from the point of view of *differential diagnosis* are: (1) affections of the gall bladder, (2) periduodenal adhesions without ulcer, (3) newgrowths in the bulb, (4) congenital duodenal diverticula. For all these affections may cause local roentgenological changes in the bulb and in the rest of the duodenum, changes which in some cases resemble closely the appearance of ulcer. Clinically it is often impossible to differentiate these conditions which may present similar subjective symptoms. It is particularly important, therefore, to attempt to establish the differential diagnosis by roentgen-ray examination and this is nearly always possible by a detailed local study.

(1) The commonest bulbar deformity in cholecystopathy is a broad rounded impression usually within the lateral or anterior bulbar wall, sometimes at the tip of the bulb and sometimes encroaching upon the terminal part of the stomach. In order to determine whether such an impression is occasioned by an enlarged or filled gall bladder it is very important to examine the patient carefully in the second oblique position in order to project clearly the anterior bulbar wall facing the gall bladder. It is further necessary to observe how this impression behaves with the patient in different positions and on manual displacement. A cholecystrographic examination may often yield further

information. A normal gall bladder may also, though rarely, give rise to an impression on the bulb, as may also a lobe of the liver or hard scybala in the colon. The impression caused by the gall bladder resembles to some extent a retraction of the bulb; in the first place, however, it does not occupy the site of predilection of the retraction, but instead the anterior or lateral bulbar wall; further, it does not possess the well-marked flattened shape of the typical retraction, but instead an evenly rounded, concave shape corresponding to the size and shape of the gall bladder; finally, it can be shown by manual displacement and a change of the patient's position that the impression can move in relation to the bulb and perhaps disappear altogether; this shows that we are dealing with a change in form that must be due to factors outside the bulbar wall.

In rare cases of dilatation of the ductus choledochus there may be seen a fairly coarse grooved impression riding obliquely across the top of the bulb at the site where normally a small incisura, occasioned by the common duct, may be rarely found.

(2) In the case of periduodenal adhesions without ulcer or in pericholecystic adhesions it is often surprising how completely lacking deformities of the bulb may be even though the bulb be quite embedded in adhesions. In other cases one finds contractions of the bulb, caused by strangulation, which clearly vary on change of position and which may even be quite obliterated in certain positions. In those cases where certain difficulties may present themselves in the making of the differential diagnosis one is often helped by simultaneous diminished displaceability, most often of a dextrofixation type and the absence of a typical ulcer deformity.

(3) Newgrowths in the bulb are rather rare. It is generally a question of papillomata, sometimes of polypi arising from the end of the canalis or pylorus; these polypi are forced out into the bulb by peristalsis, where they are freely movable, as can be seen directly on palpation under screening. The newgrowths belonging to the bulbar wall present the rather characteristic appearance of a rounded defect of the filling in the bulb not otherwise deformed. Berg has described a somewhat similar appearance in the prepyloric region in cases of enlarged perigastric glands which on compression roentgenograms may give rise by indentation to rounded defects in the relief roentgenogram.

(4) Congenital duodenal diverticula practically do not exist within the bulbar area; I have only on one occasion observed and diagnosed such a condition in the upper part of a bulb otherwise not deformed; this case was verified at operation. On the other hand it happens not infrequently that diverticula extending by narrow indistinct pedicles from the uppermost part of the descending portion of the duodenum or from the end of the duodenum in the neighborhood of the duodenojejunal flexure, become projected close to, or within, the bulbar area, and these shadows may be interpreted falsely as niches. Examination in different projections and with compression should solve the question. In the area of the superior duodenal flexure and the upper part of the descending portion of the duodenum ulcers are very rare but diverticula of rather common occurrence. Here as elsewhere the ulcers will be found to extend with a broad base from the duodenal lumen surrounded by a clear ridge and often accompanied by a corresponding contraction of the intestinal lumen (Figs. 53, 54). The duodenal diverticula lack the surrounding ridge and the corresponding contraction; they do not originate by a broad base from the duodenal lumen but by a narrow pedicle within which it is often possible to demonstrate by the compression technique longitudinal soft folds of the mucous membrane.

Clinical Importance of Bulbar Analysis. It is not only in the *diagnosis*, including the differential diagnosis, of duodenal ulcer that a precise roentgenological analysis of the bulb is of the greatest importance

but also in the various other questions pertaining to the *clinical* picture of the disease, that the roentgenological study of the bulb is in many cases of very great value: questions, such as the frequency of the duodenal ulcer, its various types, the typical periodicity of its course, the choice of suitable methods of treatment and control of the therapeutic results.

The *frequency* of proved cases of duodenal ulcer has increased enormously by the direct roentgen-ray method at the expense particularly of the gastric neuroses which have become more and more rare. Whereas seventeen or eighteen years ago the diagnosis of duodenal ulcers was only rarely established roentgenologically, at the present time with the improved technique duodenal ulcer of all the diseases in the whole of the digestive tract has become the condition most frequently diagnosed by the help of the roentgen ray.

In many cases the local roentgen-ray findings enable a differentiation between the *various types of duodenal ulcer*, viz., acute and more chronic, cicatricial shrinking types, simple and complicated forms, solitary and multiple ulcers, ulcers with a tendency to hemorrhage on the posterior wall and ulcers with a certain risk of perforation, deep niches stamped in a tap-like manner on the anterior wall. Many obscure clinical ulcer symptoms get cleared up only on roentgen-ray examination, such as severe left-sided pains and glycosuria in the case of ulcers affecting the pancreatic head either in the form of fibrous changes or penetration (Berg) and various biliary symptoms in the case of ulcers with shortening of the bulb, obliteration of the superior duodenal flexure and dextrofixation.

A periodic roentgen-ray control of the bulb may also to some extent cast light upon the tendency to *periodicity* of the disease.

When the symptoms are most pronounced then the local roentgen-ray signs are as a rule very clearly marked; this is particularly true in the case of niches.

During an interval of abated symptoms the niches are generally lacking altogether or are at least as a rule diminished, the functional and transitory deformities have more or less receded while the changes occasioned by scar formations in the course of healing have not infrequently become aggravated. During periods of renewed symptoms I have in many cases come across fresh niches arising at new places in the bulb and in some cases I have observed a recurrence or an enlargement of the niche at the site of the old one. It is not unusual that a niche may persist, even if diminished in size, after the pains have completely disappeared, and that patients with obvious niches are on the whole free from pains. On the other hand there are a good many patients having ulcer with typical hunger pains in whom no roentgenological sign of niche can be detected. No very strict connection, therefore, seems to exist between niche and pain even if, when viewed on the whole, there is a certain parallelism.

The roentgenological analysis of the bulb has perhaps its greatest value in the indications for *treatment* afforded in many cases. That the fresh, simple, uncomplicated ulcer with accompanying functional and transitory deformities belongs to medical treatment is just as certain as that the cicatricial, fibrous, markedly shrunken forms of ulcers, perhaps complicated with diverticular formation and shortening of the bulb, demand surgical intervention. In the large group of cases lying between these extremes the practitioner, in choosing a trial medical treatment, obtains a valuable support in his choice of therapy by periodic roentgen control. One case may prove to respond to medical treatment; we may be able to verify under roentgen-ray study that in a couple of weeks the ulcer crater has perhaps rapidly diminished in size during the cure and in a month or two has entirely disappeared (see Figs. 33–36). In another case the ulcer crater may obstinately resist every effort of healing by medical treatment or the healing may take place

with a tendency toward such marked shrinkage and contraction as to require surgical interference.

It seems quite possible that a still further developed and refined roentgenological analysis of the bulb may in time open up *new roads for a continued research of peptic ulcer* and thus contribute toward the solution of the many problems that remain to be solved. For it seems a very happy coincidence that precisely that limited area which above all constitutes the site of predilection of the peptic ulcer, namely, the duodenal bulb, is also that part of the gastroduodenal area where we now, thanks to the modern roentgenological method of examination in conjunction with favorable anatomical conditions, are able to make our most reliable and most detailed observations and where we are able in the easiest and clearest manner to follow the development of existing changes.

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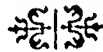
CAMPIODOL (IODIZED RAPESEED OIL)

ITS USE IN THE DIAGNOSIS AND TREATMENT OF INTRATHORACIC DISEASES*

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SAN FRANCISCO   LOS ANGELES

EXPERIMENTAL studies by Frazier and Glaser[1] first led to the synthesis of campiodol, and later to its clinical application in the diagnosis of neurological, genitourinary[2,3] and paranasal sinus[4] disorders. This work gave promise of the adaptability of the oil as an appropriate substance for the visualization of the tracheobronchial tree and for the study of intrapulmonary conditions.

We have injected campiodol into the trachea and bronchi on 150 occasions without toxic effects, and have found it quite satisfactory.

Properties of Campiodol: Campiodol is an iodized rapeseed oil of a light yellow color; it contains 43 per cent iodine and has a specific gravity of 1.289. Its viscosity is 250 at 100°F. The oil is sufficiently viscid to coat the bronchial wall; it is thin enough to enter the minor bronchial openings, is free from general and local irritative properties, and casts a clear-cut shadow on the roentgen plate. The name, "Campiodol" is derived from the Latin, *brassica campestris,* one of the plants from which rapeseed oil is obtained.

Indications for the Use of Campiodol in Chest Conditions: The indications for the use of campiodol in chest conditions are the same as those given by Sicard and Forestier,[5-7] Singer and Francis[8] for other iodized and bromized oils. It is intended to localize intrathoracic disease, to determine the type and extent of the lesion, and thereby to aid in outlining rational treatment. Without iodized oil, accurate diagnosis and localization may be impossible because of thickened pleura, pulmonary fibrosis or emphysema which, on physical examination and roentgen-ray study, tend to mask the true condition.

Campiodol is valuable also in the study of those suppurative lesions which permit pus to spill about by internal drainage[9] within the lung. In such cases without campiodol injection a correct diagnosis is difficult because the abnormal physical signs and x-ray shadows often are noted at areas which are quite distant from the primary lesion. It is to overcome these pitfalls in diagnosis that campiodol is employed, and it is of especial use when the symptoms, signs or x-ray shadows leave any doubt as to the nature, location or extent of the disease.

Contraindications in the Use of Campiodol: The oil should not be employed if there is a marked diminution of air flow associated with a low vital capacity, because under such circumstances the patient's cyanosis and dyspnea would be aggravated greatly by the introduction of any type of oil into the tracheobronchial tree. It is advisable, therefore, to postpone the use of campiodol until after the acute symptoms have subsided.

Method of Injection of Campiodol (warmed 10 to 15 c.c. oil):

A. Technique: The various methods which have been accepted for introducing iodized oil have been utilized. The particular method employed in any instance is determined by the preference of the physician, the cooperation of the patient, and the type and probable position of the pulmonary lesion. Campiodol should be slightly warmed before injection so as to make the oil more fluid. It is necessary to inject 10 to 15 c.c. of campiodol to obtain satisfactory roentgen plates.

B. Posture: The specific gravity of campiodol permits it to flow into the dependent areas; consequently, the patient must be so turned that the oil can gravitate to the region to be visualized. Injections of

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campiodol are successful only when the examiner is familiar with the relative position of the various bronchial openings,

from the upper lobe to the dependent areas.

Clinical Application of Campiodol: Camp-

FIG. 1. Campiodol infection of right lung. (Mandelbaum catheter method.) Plate normal except for narrowing between middle and lower lobe bronchi D; CA catheter in trachea; RM right main bronchus; RU right upper lobe bronchus (this bronchial opening almost directly across from bifurcation of trachea); M continuation of right main bronchus; D point of division between middle and lower lobe bronchi.

FIG. 2. Lateral view of normal right lung after campiodol injection showing anterior direction of middle lobe bronchus M and posterior direction of lower lobe bronchus L. RU right upper lobe bronchus; A anterior branches of upper lobe bronchus; D point of division between middle and lower lobe bronchi; Dotted lines indicate division of right lung into upper, lower and middle lobes.

the general direction of the bronchial stems, and the portion of the lung to which each major or minor bronchial opening leads (Figs. 1–3).

c. Fluoroscopy: By observing the patient fluoroscopically during the injection of the oil, each unit of the tracheobronchial tree may be studied as it fills, and observations may be made which would be impossible from the study of a plain x-ray plate alone.

Roentgen Plates: Immediately following the fluoroscopic instillation of campiodol, anteroposterior and lateral x-ray plates are taken with the patient in an erect position. For study of the upper lobes, the plates are taken with the patient lying flat so as to prevent the oil from spilling

iodol has been employed to advantage in the study of patients with chronic bronchitis, bronchiectasis, pulmonary abscess, bronchial fistula, bronchostenosis, tumors of the lung and mediastinum, and hernias of the diaphragm.

Pulmonary Abscess: The attempt to fill an acute pulmonary abscess has been unsuccessful so frequently that the use of the oil is becoming less universal in these cases. This is regrettable because iodized oils often can furnish information which is essential in the diagnosis, treatment and progress of this condition. It localizes the abscess accurately when surgical drainage is contemplated and determines the proper position for effective

postural drainage by visualizing its relation to the bronchial outlet.

We believe that by means of a pre-

FIG. 3. Campiodol injection of right lung (lateral view). RU right upper lobe bronchial opening. D point at which middle M and lower lobe bronchial openings communicate to form common trunk.

liminary bronchoscopic treatment to clear the passage away, and the use of proper technique, campiodol can be used successfully in a majority of these cases. The intrabronchial pus may be removed by bronchoscopic suction and the diseased bronchial opening may be treated directly with cocaine, adrenalin and silver nitrate to restore its patency.

It is not unusual for an abscess of the upper lobe to give physical findings over the entire lung. Recently, we saw a patient of this type with a left-sided pulmonary abscess of eighteen months' duration. In this instance it was impossible to localize it on the basis of physical findings alone. Campiodol injection demonstrated that this abscess was situated at the left apex and that the lower lobe was normal (Fig. 4).

When a pulmonary abscess is secondary to the direct extension of a mediastinal or subdiaphragmatic abscess, the localization of the original lesion may be determined by the injection of campiodol. In

conjunction with diagnostic pneumothorax, iodized oil affords information not only as to the presence and location of associated

FIG. 4. Pulmonary abscess of left upper lobe visualized with 15 c.c. campiodol.

pleural adhesions, but also as to the influence of these adhesions upon the abscess itself.

Bronchiectasis: The oil has proved most helpful in the diagnosis of bronchiectasis and in the differentiation of this condition from chronic bronchitis, chronic pulmonary abscess, pulmonary tuberculosis and asthma. Campiodol has enabled us to recognize unsuspected bilateral bronchiectasis and has guided surgical treatment (Figs. 5–8). Certain upper lobe bronchiectatic processes were not recognized on physical examination, or on plain x-ray plates until the introduction of campiodol (Figs. 9 and 10).

Bronchostenosis: Following campiodol injection, a presumptive diagnosis of bronchostenosis may be made when the oil fails to enter a given bronchus (Figs. 11

FIG. 5. Bronchiectasis. Chest plate before injection of campiodol. Clinical diagnosis: Bronchiectasis and chronic emphysema. X-ray diagnosis: Infectious process at right base. Physical findings strikingly similar over both lungs.

FIG. 6. Same patient as Fig. 6 after campiodol injection. Note grape-like cluster of saccular bronchiectatic pockets partially filled with campiodol fluid levels. Left lung was not injected at this sitting, but appears clear.
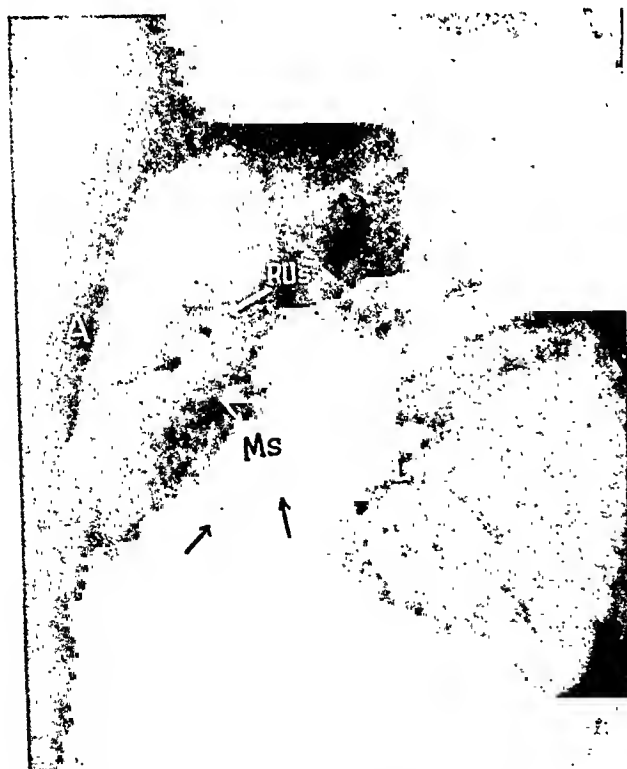
FIG. 7. (Same patient as Fig. 5.) Right lateral view after campiodol injection. There are a great number of clustered saccular bronchiectatic pockets filled with campiodol and occupying practically entire middle lobe MS. Note campiodol filled saccular bronchiectatic pockets with fluid levels at anterior portion of base of right upper lobe RUS. Bronchi at base of lower lobe L are well visualized. A, anterior chest wall.
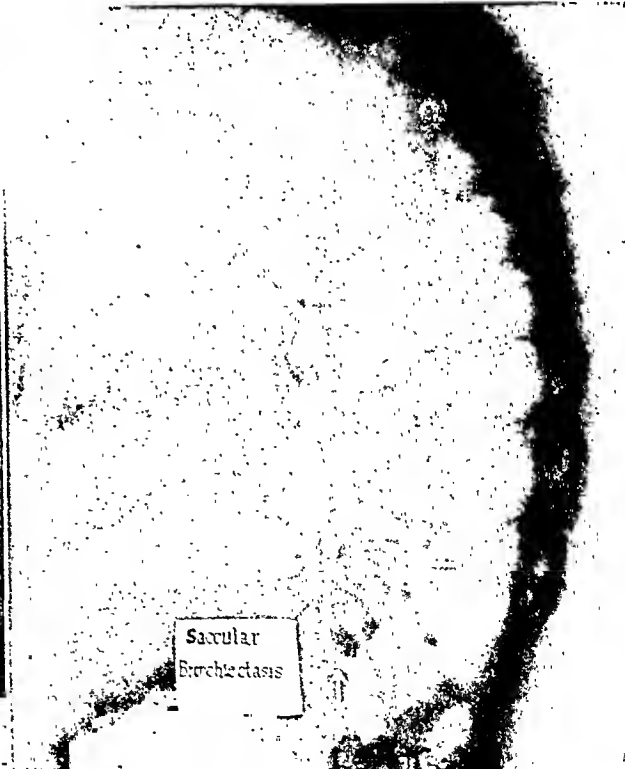
FIG. 8. (Same patient as Fig. 5.) Lateral view of left lung. Upper lobe bronchi are normal. Marked saccular bronchiectasis of lower lobe.

[525]

FIG. 9. Campiodol injection of right lung in patient who has had partial posterior thoracoplasty. Arrow points to large dilated cylindrical and fusiform bronchi at base of right upper lobe which were not suspected before campiodol injection. Bronchi of lower lobe are normal.

FIG. 10. Campiodol injection right lateral view of same patient as Fig. 9. Bronchiectatic involvement limited to anterior portion of right upper lobe.
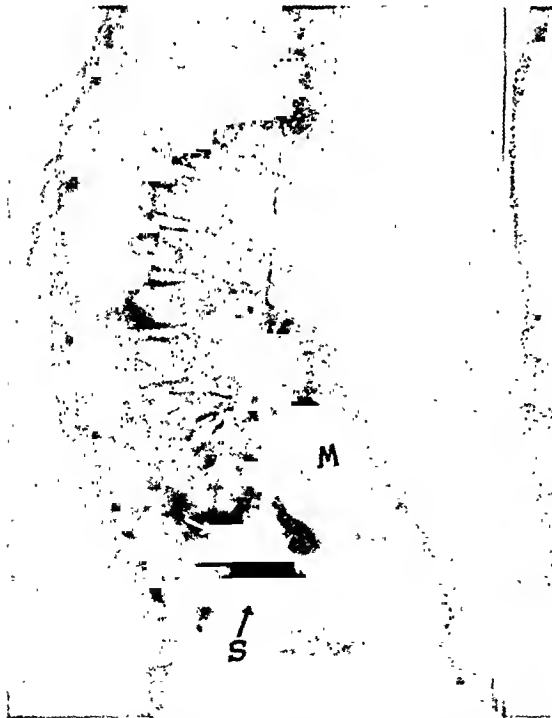
FIG. 11. Bronchostenosis. Campiodol injection by crico-thyroid puncture showing saccular bronchiectatic pockets (s) at posterior portion of right lower lobe. Middle lobe M is not visualized. Campiodol did not enter this area. Bronchoscopic examination confirmed campiodol diagnosis of bronchostenosis caused by inflammatory edema.

FIG. 12. Campiodol injection of right lung (lateral view). Upper lobe bronchi RU and lower lobe bronchi L are well visualized but middle lobe bronchus should normally be seen. D, point of division between middle and lower lobes. Ca, catheter in trachea. Broncho-scopic examination confirmed diagnosis of bronchial occlusion due to an inflammatory process.

and 12). There are many factors that govern the good visualization of the lung and the iodized oil injection usually

roentgen shadows give even the least suspicion of a growth (Figs. 13–16).

Empyema and Bronchial Fistula: In the

FIG. 13. Left main bronchus and left upper bronchus (LU) outlined by campiodol. No campiodol entered left lower lobe bronchus (LL). C, carina (bifurcation of trachea). Bronchoscopy confirmed campiodol diagnosis of left lower lobe bronchial occlusion. Occlusion due to primary carcinoma of bronchus.

FIG. 14. Primary carcinoma of bronchus. (Same patient as Fig. 3.) Lateral view after campiodol injection showing funnel-shaped left lower lobe bronchial occlusion (LL) caused by primary carcinoma of bronchus. LU, left upper lobe bronchi.

does not give definite information as to the nature of the occlusion. Consequently, bronchoscopic examination should be employed to permit direct inspection of the occluded area. The combined use of bronchoscopy and campiodol cannot be too strongly recommended in these cases.

Intrabronchial Tumors: Iodized oils should not be relied upon in the diagnosis of intrabronchial tumors because the tumor may be so small, or situated in such a position that the oil fails to reveal it. Bronchoscopic examination is the most valuable diagnostic procedure in these cases. By this means a very small tumor may be detected and a biopsy obtained long before abnormal physical signs, or

investigation of patients who have chronic empyema, the use of campiodol should be limited to those in whom the physical signs and x-ray findings are inconclusive as to the size of the empyema pocket, the extent of the lung expansion, the presence of a bronchial fistula, or the existence of underlying intrapulmonary disease. The oil is usually introduced through the drainage tube into the pleural cavity, but whenever the chest wall sinus has closed previously, campiodol is injected through the mouth. This permits a visualization of the lung so that the amount of lung expansion can be determined easily. If a bronchial fistula is present, the oil flows from the tracheobronchial tree into the pleural cavity (Figs. 17–21).

FIG. 15. Campiodol instilled through bronchoscope into middle lobe bronchial opening overflowed in lower lobe bronchi without giving middle lobe visualization. This indicates an obstruction of middle lobe bronchus which was caused by tumor (T).

FIG. 16. Plain x-ray plate demonstrated large mediastinal mass between trachea and left main bronchus. Campiodol injection of left upper lobe showed no involvement of bronchi or lung itself. Bronchoscopy and diagnostic pneumothorax confirmed campiodol diagnosis of extrabronchial tumor.

FIG. 17. Before campiodol injection showing left-sided empyema drained by catheter CA. Chest appears clear. No roentgenological evidence of unobliterated empyema pocket or bronchial fistula. On basis of clinical and x-ray findings the catheter would be removed. (Compare with Figs. 18 and 19.)

FIG. 18. (Same patient as Fig. 17.) Campiodol injection through drainage tube into left pleural cavity. Residual empyema pocket (E) is present. Bronchial fistula present and permit oil to flow into bronchi of left lower lobe (LL), and across into right lung to faintly visualize lower portion of right upper lobe (RU), and point of division between right middle and lower lobe (D).

FIG. 20. Same patient as Fig. 18, three weeks later. Campiodol injection into pleural cavity. Empyema pocket practically obliterated.

FIG. 19. Plain x-ray plate of same patient (Fig. 18) taken three weeks later. Note small tube draining left pleural cavity.
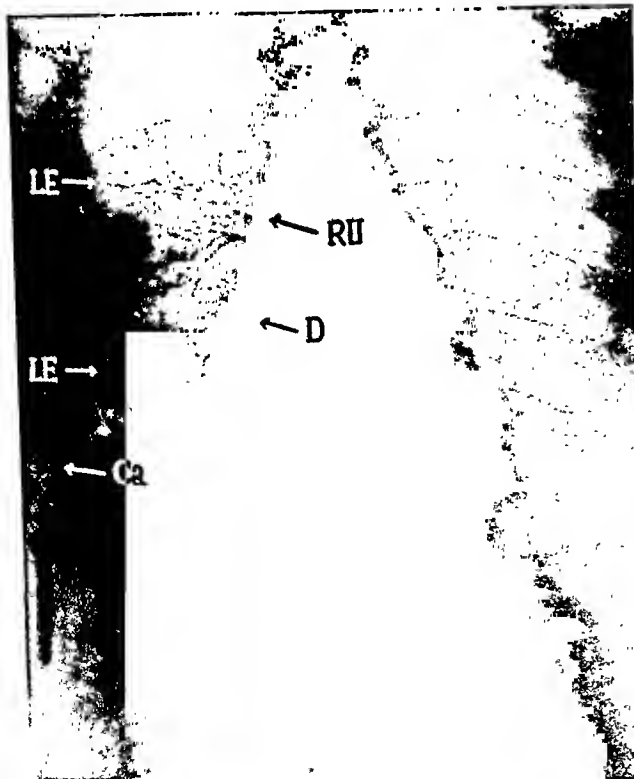
FIG. 21. Campiodol injection in patient with right-sided chronic empyema. Presence of bronchial fistula suspected. Oil introduced through mouth into tracheobronchial tree. Bronchi on right side well visualized; lung has not expanded sufficiently to reach lateral chest wall; no evidence of bronchial fistula. LE, lung edge; RU, right upper lobe bronchus; D, point of division between middle and lower lobe bronchi; CA, catheter draining empyema pocket.

FIG. 22. Campiodol injection of right middle and lower lobe bronchi. Shadow H at lower anteror portion of chest due to hernia of diaphragm. Middle lobe raised by hernial protrusion and lower lobe bronchi L pushed posteriorly. U.L., bronchus to lower portion of upper lobe.

Hernia of the Diaphragm: Campiodol often permits a recognition of these conditions by visualizing the displaced bronchial trunks upon which the hernial sac encroaches (Fig. 22).

Treatment: A few patients had temporary relief from symptoms following the injection of campiodol. This relief did not persist and was not always obtained following the second injection.

CONCLUSIONS

1. Campiodol (iodized rapeseed oil) is inert, non-irritating and non-toxic, and possesses good shadow-casting properties.

2. Campiodol is of definite value in the diagnosis of intrathoracic diseases.

3. Campiodol has been used successfully to visualize the tracheobronchial tree in 150 occasions.

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THE CHRONICITY OF ULCERS IN THE STOMACH AND UPPER INTESTINE

1. SUSCEPTIBILITY OF JEJUNUM TO ULCER FORMATION
2. EFFECT OF DIET ON HEALING OF ACUTE GASTRIC ULCER

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NO one who has devoted considerable time to the investigation of the etiology of ulcer of the stomach and upper intestine believes that the problem is settled. It is known that a number of factors may be responsible for the development of the acute lesions and for delaying their healing. Which is the factor of prime importance, or whether there is a single factor of prime importance, is a question that cannot be answered with certainty at the present time, in spite of the great amount of investigative work that has been done.

It is granted by practically every investigator that acute lesions of the gastric and duodenal mucosa produced experimentally in "normal" men and animals heal rapidly; and, as Aschoff[1] has remarked, "One asks in amazement, why, with the marked healing power of the gastric mucosa, ulcers develop at all, and why all erosions of the stomach mucosa do not result in healing."

Our observations on the genesis of erosions have been reported previously[2-4] and can be summarized by the statement that a procedure which causes spasm or violent contractions of the musculature produces hemorrhages into the mucosa, which in the presence of digestive juices are converted into erosions or superficial ulcers of variable depth and size depending on the extent of the hemorrhage. A diagram by Smithies[5] and the discussion of Aschoff[1] clearly elucidate this view.

INFECTION

It has been abundantly demonstrated by numerous workers, more recently by Nickel and Hufford[6] and Saunders,[7] that streptococci can be isolated from most ulcers of the stomach and duodenum and that the intravenous injection of such organisms causes acute lesions of the mucosa. The mechanism by which these organisms operate to produce the lesion is a mooted point. They may operate by "specific elective affinity," by serving as emboli, or by causing gastric or duodenal spasms which cause petechial hemorrhages that become secondarily infected. Our observations support the latter view, since histamine,[8] toxins,[1] foreign protein[7] and injections of various things which cause a fall in blood pressure produce either asphyxial or "drug-like"[9] spasms of the musculature analagous to those which occur in vomiting. We should like to point out that this view is not entirely incompatible with the "specific elective affinity" view, since one organism may produce more of the spasm-exciting substance than another and the degree of spasm may vary from animal to animal.

We have prepared dogs with a pouch of the pyloric antrum[2] and have injected streptococci isolated from two human gastric ulcers by the Rosenow technique and virulent streptococci from a case of osteomyelitis. In the pyloric pouch one can control all factors and can observe at will the results. The cultures were injected in the epiploic arteries of the pouch and submucosally in 5 dogs each. Only local areas of edema and congestion resulted which disappeared within three days. The virulent streptococci when injected intraperitoneally killed dogs in eighteen hours,

when injected submucosally in the pouch caused a marked congestion and edema which disappeared in four days, and when

FIG. 1. Chronic ulcer in rabbit's stomach produced by excising mucosa and closing muscularis and serosa with silk and placing animal on rough diet. This particular animal was on a diet of dry rolled oats. A gut suture proved to have same effect as a silk suture.

injected subcutaneously produced a huge abscess. Previously[3] we manipulated acute ulcers produced by excision with various virulent organisms and found no delay in healing that could not be accounted for by the mechanical effect of the manipulation itself. Saunders[7] attempted to directly infect the gastric mucosa with the organism he studied, but obtained negative results. He pointed out that this strongly suggests that those experimenters who have produced erosions and small ulcers by injecting broth cultures were obtaining a foreign protein anaphylactic type of reaction which is produced with peptone.

Since it was impossible for us to produce ulcer by directly infecting the pyloric mucosa of dogs with organisms isolated from human gastric ulcer or by virulent organisms from other sources with all other possible factors controlled, we can only conclude that if chronic ulcer of the stomach is due to infection, either the dog has a high natural immunity which we doubt, or a very highly specific organism is required, or other essential factors must

be associated with the infection. It is possible that an infection of the tissues about an acute ulcer may cause production of connective tissue or inhibition of proliferation of mucosal cells, which in the presence of other factors conducive to chronicity will result in a chronic ulcer.

MECHANICO-FUNCTIONAL FACTOR

The mechanical factor is important in determining the healing time of an acute ulcer. It has been experimentally demonstrated that pyloric stenosis per se does not give rise to gastric ulcer,[2,10] but given an acute ulcer, pyloric stenosis delays healing.[2,11,12] One of us[3] has shown, with other factors controlled, that manual manipulation of an acute ulcer in a pyloric pouch delays healing, but per se does not result in a chronic ulcer. Manipulation of the ulcer with cotton soaked with 0.4 per cent hydrochloric acid[4] to the point of bleeding twice daily showed that healing was not prolonged longer than by simple manipulation. However, manipulation with acid caused the ulcers to bleed sooner than otherwise and the experiments should be repeated keeping the time factor constant.

The clinical and pathological evidence bearing on the mechanico-functional factor is discussed by Aschoff,[1] who is an advocate of this view. That clinicians believe this to be an important factor is shown by the fact that all use in their management of ulcer patients a liquid or soft diet, with or without starvation and atropine, the diet frequently containing fat which when undigested inhibits motility and secretion. In addition, it is well known that coarse particles of food remain in the stomach longer than finely divided particles.

In view of this evidence we decided to make a study of the consistency of the diet on the healing of acute lesions of the stomach.

Roughage in Diet a Factor: We were stimulated by the work of Ferguson[13] who reported that if a piece of mucosa were excised from the stomach of rabbits and the incision in the muscularis and serosa

closed with a silk suture, and the rabbits kept on a stock diet of hay, oats and carrots, a chronic ulcer would result which in some cases would remain for from two to eight months or even longer.

Our observations[14] can be summarized as follows: A simple ulcer of the rabbit's stomach from 1.5 to 2.0 cm. in diameter produced by excision heals in thirty days irrespective of the consistency of the diet. A similar ulcer, but with a silk or chromic gut suture in its base, will heal if the rabbit is fed a diet of milk, bread, and boiled, mashed carrots, but will tend to become chronic if the rabbit is fed a diet of hay, oats, and raw carrots (Fig. 1). The roughage of the diet has an influence on the healing of an acute gastric ulcer, when other factors, such as the foreign body in these experiments, are operating simultaneously which tend to delay healing.

This method renders it possible to study the food buffer and fat factors experimentally.

The mechanical factor obviously operates through trauma by preventing the proliferating mucosal cells from gaining a foothold on the base of the ulcer and by causing local edema, bleeding or congestion.

THE BLOOD FLOW AND FIBROBLASTIC REACTION FACTORS

The fibroblastic reaction and the character of the blood flow about the edges of the acute ulcer must be considered in an analysis of the chronicity factors. It is well known that the fibroblastic reaction following trauma varies in different individuals, some showing little and others excessive proliferation. The anatomical studies of Reeves[15] reveal that the regions of atypical vascularity, of poorest blood supply and of greatest fixation of the stomach and duodenum are those regions in which ulcers are most commonly found.[16] It is well established that experimental acute ulcers of the fundus heal more rapidly than ulcers of the pylorus, lesser curvature and first inch of the duodenum; and Morton[17] has found that ulcers of the

pylorus and lesser curvature show greater tendency to become chronic. Dragstedt and Vaughan[18] have found that if a silk suture

FIG. 2. Ulcer (just inside of dotted line) that occurred along suture line in gastric operation in which too much umbilication or infolding of mucosa was done.

is placed in the base of an acute gastric ulcer in the dog, an indurated ulcer frequently results as was found by us in the work referred to previously on rabbits. Chronic ulcers of the stomach and intestine can be produced with x-rays. X-rays first cause a delay in fibroblastic proliferation[19-22] and later there results an overproduction which leads to an indurated ulcer that does not heal readily. The epithelial cells, of course, as well as the blood vessels are affected. In the course of our work on gastric secretion, we have performed many operations on the stomach in which we used silk as a suture material. No ulcers have ever occurred along the line of incision unless a portion of the gastric mucosa a centimeter or more in length is umbilicated into the lumen of the stomach. When this is done, a typically chronic indurated ulcer results in the umbilicated portion along the suture line (Fig. 2). The factors concerned are, we believe, (a) connective tissue proliferation about the silk suture, (b) congestion of the mucosa due to the umbilication, and (c) greater exposure of the umbilicated mucosa to mechanical trauma. (This is analogous to the suture line ulcer following gastro-enterostomy, we believe.) Excessive con-

nective tissue proliferation about the ulcer, we believe, reduces the functional blood supply to the mucosal cells which must

FIG. 3. Ulcers, "kissing" in type, which occurred spontaneously in a dog which died three months after common bile duct ligation.

proliferate and grow in order to heal the defect. It also decreases the local motility of the mucosa and exposes it to greater mechanical trauma.

ALLERGY

Shapiro and Ivy[23] were able to produce acute ulcers of the gastric and duodenal mucosa in dogs on applying the principle of local anaphylaxis, but were unable to cause them to become chronic by continued application of the antigen because of desensitization. Although they were unable to obtain chronic ulcers they suggested that chronicity may be established in man by a repetition of local reactions until irrevocable fibrosis develops.

NUTRITION

One of us has shown that experimental acute ulcers of the stomach and duodenum heal slowly or become chronic when produced during a period in which the dog is suffering from some infectious disease, nutritional disturbance, or disturbance of normal digestion, such as distemper, common bile duct ligation, pancreatic duct ligation, Eck fistula or a poorly functioning gastroenterostomy.[2,3] Besides the data previously recorded we have found at autopsy spontaneous ulcers of the "kiss-

ing" type in 2 dogs with common duct tied (Fig. 3) and in 6 dogs out of 61 (Fig. 4) in which the pancreatic ducts were tied,

FIG. 4. Ulcers, "kissing" in type, which occurred spontaneously in a dog which died two months after ligation of pancreatic ducts. Six ulcers were found in 61 dogs so operated.

and a single chronic perforating ulcer in 2 Eck fistula dogs. Berg, Johnston and Jobling[24] observed a high percentage of ulcers in dogs with a biliary fistula. In a dog with a pyloric pouch and during an attack of diarrhea of unknown etiology which lasted about one week, we excised a piece of mucosa 1 cm. in diameter. This ulcer persisted for seven months when the animal was killed.

Although we believe the nutrition or the general condition of an animal to be an important factor in the chronicity of experimental ulcer, we realize that it is not a factor which operates in many human cases of ulcer and does not satisfactorily explain certain types of experimental ulcer to be discussed later in this paper.

CORROSIVE OR IRRITATIVE ACTION OF GASTRIC CONTENTS

The irritative or corrosive action of gastric contents is a generally accepted factor in determining the chronicity of ulcer. It might seem obvious to some that it should be considered as a prime factor. However, there is experimental evidence which questions the possibility of its being a prime factor. Acute lesions of the mucosa of the stomach and duodenum of normal man and dog heal quite rapidly in spite of the corrosive action of gastric juice.

Mann[25] has transplanted jejunal mucosa into the anterior wall of the stomach without obtaining ulcers, which we have confirmed in 4 dogs, our transplants being made from ½ to 1 in. proximal to the pyloric sphincter. Dragstedt and Vaughan[18] have exposed the mucosa of various parts of the alimentary canal, and the parenchyma of the spleen and kidney to the action of gastric contents without obtaining corrosive lesions (also see Ref. 26). Necheles, Ling and Fernando[27] have implanted kidney, liver and omentum into the upper duodenum and jejunum of dogs without digestion. The tissues just mentioned are not digested as long as they have an intact circulation, whereas skin, muscle, bone and connective tissue are digested without regard to blood supply. de Takats and Mann[28] made transplants of jejunum into the lesser curvature of the stomach and observed the development of ulcer in the transplant in 3 out of 25 experiments. Although they claim the blood supply was intact in all cases, one cannot feel certain that the blood supply was not disturbed, in the cases in which ulcer developed, by the peristaltic activity and incident tugging on the pedicle of the transplant with it in such an anatomical position. The protective mechanism of the tissues which resist both gastric and pancreatic digestion is still a matter for speculation, but all agree that it is intimately associated with an active circulation of blood.

There is considerable evidence indicating that the corrosive action of gastric juice is a factor in chronic ulcer. Normal/10 HCl and gastric juice are known to be irritating to intestinal mucosa, even though the mucosa can neutralize considerable acid.[29] In the course of our work on gastric secretion we have had occasion to apply gastric juice to the mucosa of pouches of the pyloric antrum, duodenum and jejunum, and have observed that pure gastric juice will usually within a half-hour cause the jejunal mucosa to bleed, a longer time being required to cause bleeding from the duodenal mucosa. The pyloric mucosa

does not bleed readily when gastric juice is applied to it, but either daily application of N/10 HCl after several days, or appli-

FIG. 5. Jejunal ulcers, following anastomosis of end of stomach to side of jejunum and diversion of alkaline juices to ileum. Ulcers occurred in 5 of 11 dogs. When duodenum was used instead of jejunum ratio was 2 ulcers in 40 dogs.

cation of the acid plus manipulation will cause it to bleed.[30,31] Bleeding from the intestinal mucosa is also caused more readily with N/10 HCl than with gastric juice. Further, many clinicians insist that alkalies favor the healing of ulcer in man, and Dragstedt and Vaughan[18] found that alkalies facilitated the healing of the ulcers produced by their method. However, it should be pointed out that alkalies affect the motor activity of the stomach as well as neutralize acid, and numerous clinicians report healing of ulcer under managements that do not include alkalies. The first most convincing evidence supporting the view that the corrosive action of gastric juice is a factor is found in the experiments of Mann and Williamson.[32] They diverted the pancreatic juice and bile to the lower ileum and observed ulcers to appear in the intestine near the site of the gastro-enterostomy. Since they occurred rather constantly in a particular region, they believed that a mechanical factor was also operating. This view is supported by the more recent observations of Morton[17] in which he found that if measures were used to introduce alkalies in the region of the

Operation	No. of Dogs	Ulcers	Percentage
I. Gastroduodenostomy, end of stomach to side of duodenum. Large orifice.....	30	0	0
II. Same as I but using clamps.* (The five dogs did not do well after the operation.)	40	5	12.5
III. Gastroduodenostomy, end-to-end. (The ulcer dog had a stenosis with hypertrophy of the stomach.).........	5	1	20
IV. Duodenoesophagostomy. (Gastrectomy)	14	0	0
V. Same as I but with drainage of alkaline juices to lower ileum.................	20	2	10
VI. Gastrojejunostomy end of stomach to side of jejunum with large orifice. Drainage of alkaline juices to ileum....	11	5	45
VII. Gastrojejunostomy, end of stomach to end of jejunum. Drainage of alkaline juices to ileum....................	4	4	100
VIII. Gastrojejunostomy, end of stomach to end of jejunum. Drainage of alkaline juices to stomach.................	12	2	16
IX. Same as VIII but drainage to ileum established four months after operation in VIII had been done..............	8	7	87
X. Duodenojejunostomy, about 1 in. from pyloric sphincter. Drainage of alkaline juices to ileum....................	11	jejunal ulcers 8	72

* This is the only time clamps were used and care was exercised not to traumatize with forceps and fingers.

ulcer or to reduce the force of the ejection of acid chyme healing occurred.

On a number of occasions one of us (Ivy) has publicly announced the belief that the ulcers of Mann and Williamson and Morton were due to the initial trauma with fingers or instruments which caused an acute lesion and which would not heal because of the disturbance of digestion and nutrition caused by diverting the pancreatic juice and bile to the lower ileum, or the prime factor in the genesis of these ulcers was a disturbance of nutrition and not acid. Although we maintain that this nutritional factor must always be kept in mind, we no longer hold that opinion. Our former opinion was based on the following evidence: (1) It had been shown that an acute lesion produced in dogs with pancreatic ducts ligated either became or tended to become chronic. (2) It was subsequently observed by us that ulcers occurred (6 out of 61 dogs) spontaneously after ligating the pancreatic ducts and that 5 out of 6 of these ulcers were of the "kissing" type and occurred at the point where the duodenum is grasped with the fingers to dissect out the lesser duct (Figs. 3 and 4). Also, spontaneous ulcers were occasionally found in dogs after such operations as common duct ligation, Eck fistula operation and right adrenalectomy in which pressure is sometimes exerted on the duodenum during the course of the operation. (2) Further, ulcers were found[3] in 5 out of 40 dogs in which a gastroduodenostomy had been done with the use of a clamp on the duodenum (Table I), and the ulcers occurred only along the clamp line and in dogs that did not do well postoperatively, which has been confirmed in part by Gallagher.[33] (3) In addition, Balfour, on reviewing 270 cases of gastrojejunal ulcer in man, found that in one-fifth of these cases no free HCl was found on repeated gastric analysis. (4) And finally, one of us, (Ivy) has performed 20 gastroduodenostomies of the Polya type, end of stomach to side of duodenum (stomach sectioned 1 in. proximal to pyloric sphincter), in which a clamp was not placed on the duodenum and special care was taken to avoid trauma to the mucosa, and in which the bile and pancreatic juice were diverted into the last 15 in. of the ileum, with the result that only 2 ulcers occurred (Table I, Fig. 10). We no longer hold the opinion expressed before for the following reasons: (1) We have repeated with the same technical care the experiment of Mann and Williamson of making an end-to-end gastrojejunostomy with surgical drainage of the duodenum and have confirmed their findings (Table I), and ulcers occurred in some dogs that maintained their body weight fairly well. (2) Mann and Morton have shown that if after the ulcer has appeared in their experiment, they divert the gastric contents to a new point in the jejunum, the

ulcer heals and a new ulcer occurs at the site of the second anastomosis. (3) And finally, by using two different types of

the duodenal mucosa (Table 1) (Figures 11 and 12).

Gastrectomized Dogs: Duodenoesophogeal

FIG. 6. Four ulcers in jejunum with end-to-end gastro-jejunostomy which developed after diversion of alkaline juices from the stomach to the ileum. 1 is site at which alkaline juices had been diverted into stomach, not an ulcer. No ulcers developed while alkaline juices were being emptied into stomach; but ulcers 2, 3, and 4 and 5 developed two months after alkaline juices were diverted into ileum. 6 is line of anastomosis.
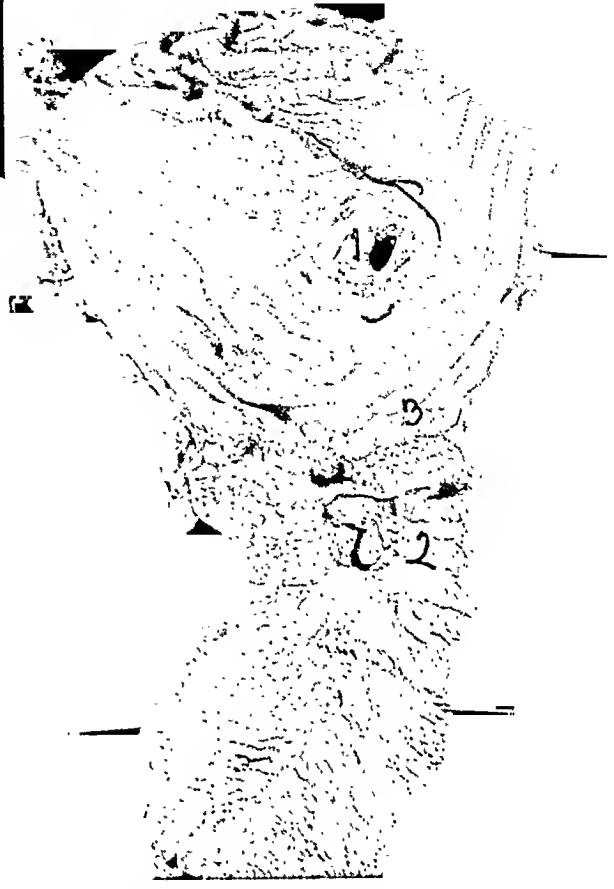
FIG. 7. Single ulcer in jejunum with end-to-end gastro-jejunostomy which developed after diversion of alkaline juices from stomach (1) into ileum. 3 is line of anastomosis. 1 not an ulcer, but lumen of jejunal stump.

technique to be described later, we have obtained jejunal ulcers in dogs whose body weight was not markedly disturbed until after the ulcer was well under way, again confirming the findings of Mann.

MUCOSAL SUSCEPTIBILITY

Mucosal Susceptibility vs. Gastric Motor Drive vs. Irritating Properties of Gastric Contents: Observations cited before (Figure 10) and to be cited later in this section of our paper caused us to ascertain whether or not the jejunal mucosa was more susceptible to ulcer producing factors than

anastomoses have been performed in 14 dogs which have lived from seven months to five years. The dogs were fed ground meat (brought to the boiling point), bread and milk. No duodenal ulcers developed in these dogs, which shows that the food itself is not irritating to the duodenal mucosa.

Gastroduodenostomy End-to-end: In five dogs we simply cut through the pyloric sphincter and resutured. One of the 5 dogs developed a duodenal ulcer and died of a perforating gastric ulcer. This dog developed a pyloric stenosis with hypertrophy of the stomach which possibly accounts for the ulcers. The 4 other dogs lived for one year without developing ulcers. This shows that one must be careful

in making such an anastomosis, and to avoid stenosis and gastric retention.

Gastrojejunostomy End-to-end with Drain-

Gastrojejunostomy End of Stomach to Side of Jejunum with Drainage of Duodenum into Ileum: Since we obtained such a low
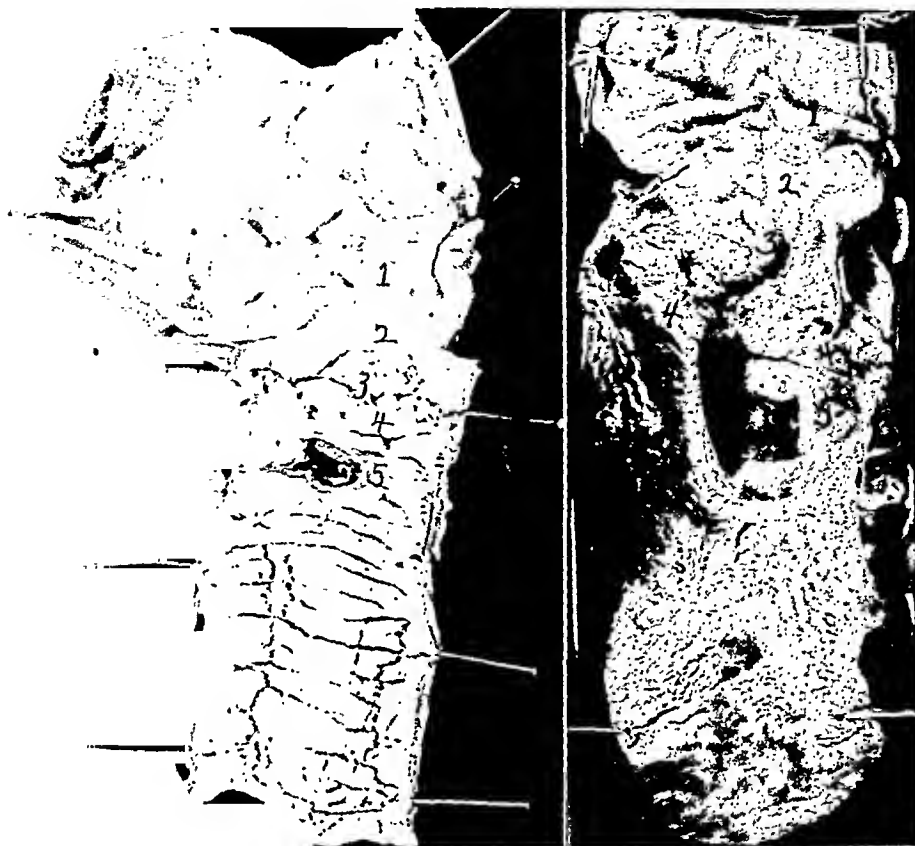
FIG. 8. Single ulcer in jejunum with end-to-end duodenojejunostomy and diversion of alkaline juices to ileum. 1, pyloric antrum; 2, pyloric sphincter; 3, duodenum (fissure due to formalin fixation); 4, line of anastomosis of duodenum to jejunum; 5, ulcer in jejunum 1 cm. below line of anastomosis.

FIG. 9. Single ulcer in jejunum with end-to-end duodenojejunostomy and diversion of alkaline juices to ileum. 1 pyloric antrum; 2, pyloric sphincter; 3, duodenum; 4, line of anastomosis; 5, ulcer in jejunum upper edge at line of anastomosis. Base of this ulcer was formed by distal blind end of duodenum.

age of Duodenum into Ileum: In 4 dogs the Mann and Williamson technique was followed by anastomosing the jejunum to the pylorus, end-to-end, and draining the duodenum into the last 15 in. of the ileum (Figure 10B). All 4 dogs developed perforating jejunal ulcers. As was found by Mann and Williamson, one can diagnose the time of occurrence of the ulcer by vomiting, anorexia, slow eating and intermittent eating and loss of weight.

Since we were very careful not to traumatize the jejunal mucosa and because of the striking confirmation of the results of Mann and Williamson and Morton, we did not operate a larger group of dogs.

percentage of ulcers when the end of the stomach was anastomosed to the side of the duodenum with drainage of pancreatic juice and bile to the ileum, we decided to perform the same operation with the modification of anastomosing the stomach to the jejunum. We thought, which is likely, that when the end-to-side anastomosis is made instead of the end-to-end, the gastric motor drive and gastric retention are less which might account for the small percentage of ulcers.

So we anastomosed the end of the stomach to the side of the jejunum and diverted the alkaline juices to the ileum in 11 dogs. Jejunal ulcers occurred in 5.

The dogs developed the ulcer and died in approximately two months. All dogs survived the operation longer than six weeks, drained the duodenum into the stomach about 1 in. proximal to the pyloric sphincter (Fig. 11B). After four months we per-
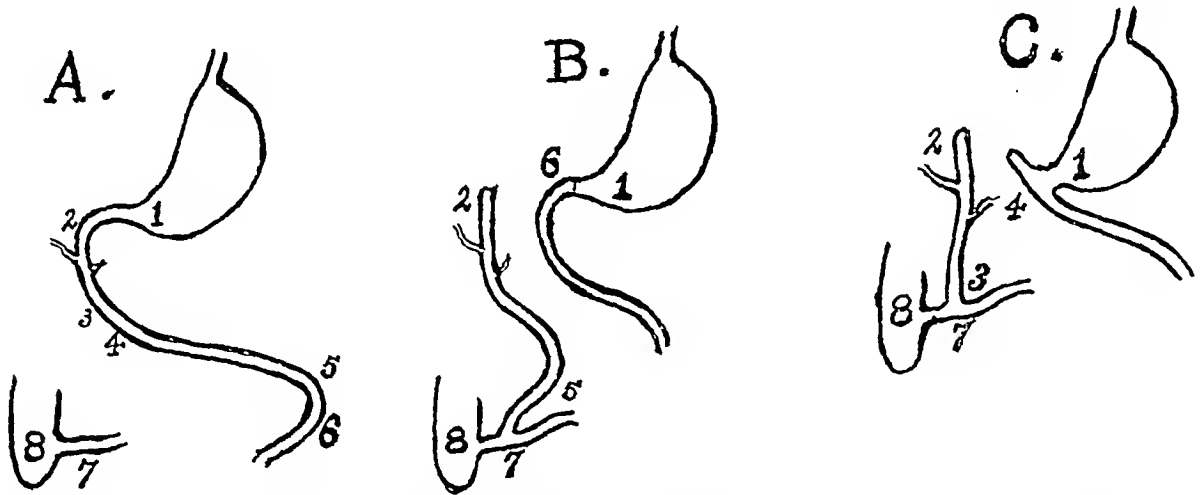
FIG. 10. Different types of gastroenterostomy performed. A is the key to diagram B and C. 1 pyloric antrum; 2 beginning of duodenum; 3 and 4, site of end-to-side gastroduodenostomy; 5, and 6, site of end-to-end gastro-jejunostomy. 7 last few inches of ileum, and 8 the caecum. B type of operation in which large percentage (80-90 per cent) (100 per cent in our series) of ulcers develop in jejunum at 6. This is the Mann and Williamson operation. C type of operation in which only a small percentage (10 per cent) of ulcers develop in duodenum at 4. Orifice in operation C larger than in B, also jejunum is used in B and mid-portion of duodenum in C.

most of them for four months and one was killed at six months without an ulcer (Fig. 5).

These results show, first, that the jejunum was more susceptible to the gastric contents than the duodenum when compared to the incidence of ulcer following gastroduodenostomy, and second, that the larger orifice which one produces when anastomosing the end of stomach to side of the intestine is a factor, since ulcers occur more frequently when the end of the stomach is anastomosed to the end of the jejunum than when the end of the stomach is anastomosed to the side of the jejunum. The results do not show whether the smaller orifice operates by causing retention which increases gastric acidity, or by increasing motor drive. Both factors may be concerned.

Gastrojejunostomy End-to-end with Duodenal Drainage into Stomach, then Later into the Ileum of the Same Dog: We desired to keep constant the jejunal susceptibility and orifice size factors and to vary only the duodenal drainage factor. In order to do this we anastomosed the end of the jejunum to the end of the stomach and

formed a second operation at which we proved the absence of an ulcer, and transferred duodenal drainage from the stomach to the ileum (Fig. 11C). Twelve dogs were operated, 2 dying of distemper sixty days after the first operation without ulcer. Two of the remaining 10 died of ulcer, 1 at fifty-four days, the other at about four months after the first operation. The remaining 8 had no ulcer at the time of the second operation four months after the first operation. Seven of the 8 developed jejunal ulcer, 5 of the 7 perforating. The remaining dog died of inanition at fifty-five days without ulcer. The time of perforation after the second operation varied approximately from three weeks to three months (Figs. 6 and 7). This shows, first, that a small percentage of jejunal ulcers will result as a consequence of the operative procedure with the alkaline juices emptied into the stomach, and second, that in an attempt to control all factors and modifying only the point of entrance of the alkaline digestive juices, the jejunum manifests a susceptibility to the irritating action of gastric contents. It is true, however, that the second operation interferes more with

the nutrition of the animal than the first operation.*

Duodenojejunal Anastomosis with Drain-

ulcer occurs in both duodenum and jejunum, it would mean that the acid factor was the chief cause. If an ulcer occurs
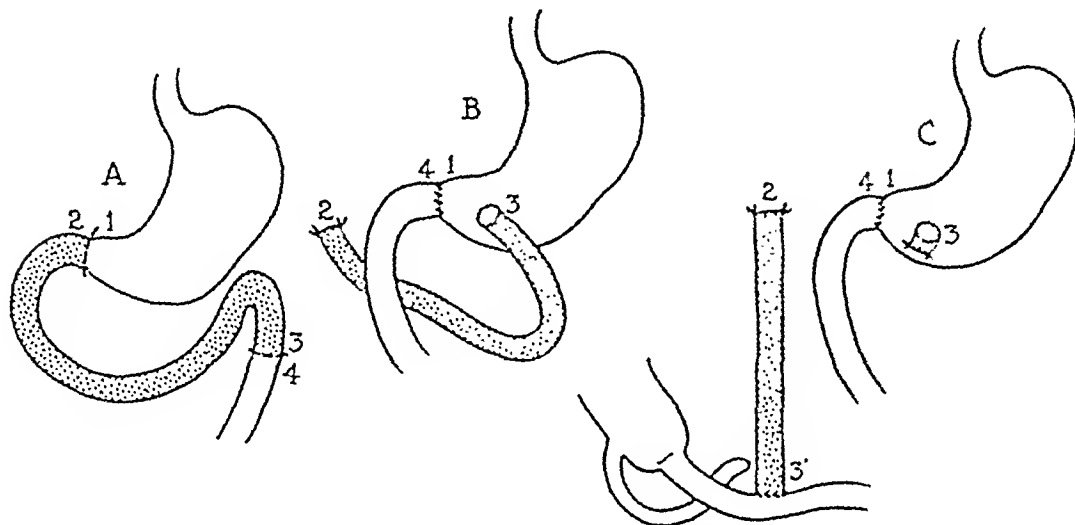
Fig. 11. Type of operation performed. A, key to diagrams B and C. 1, pyloric antrum; 2, beginning of duodenum. 3 and 4, proximal and distal end of sectioned jejunum. In B alkaline juices are drained into stomach for four months; then as in C they are drained into lower ileum. Incidence of ulcer in B, 16 per cent; in C, 87 per cent.

age of Alkaline Juices to Ileum: From our study and that of Mann and his colleagues, it is quite evident that 3 factors have become paramount in the etiology of jejunal ulcer following gastroenterostomy, namely, the irritating action of gastric contents, gastric retention and motor drive, and jejunal mucosa susceptibility.

In order to analyze these factors further, and in the same dog compare the susceptibility of the duodenal and jejunal mucosa to gastric contents, we sectioned the duodenum from ¾ to 1 in. below the pyloric sphincter, and anastomosed the jejunum to the duodenum and drained the alkaline juices into the last 15 in. of the ileum[34] (Fig. 12). The principle of the operation is that the acid factor is constant for both duodenal and jejunal mucosa and that the motor drive of the ejected contents should affect chiefly the duodenal mucosa. If an ulcer occurs only in the duodenal mucosa, it would be due to the acid plus the motor drive factor. If an

* Marked enlargement of the colon was present in all dogs at second operation but had practically disappeared at time of autopsy. The dogs were fed a diet of yellow corn meal, bread and bone scrap soup.

in the jejunal mucosa only, it would mean that its mucosa is more susceptible to the action of the gastric contents.

Twelve dogs were operated on. One died at two weeks due to pernicious vomiting with no ulcer, and another died at five months without an ulcer. Of the remaining 10, 8 died with perforating or fatal bleeding, jejunal ulcers. All the ulcers were in the jejunum, the cephalad edge being at the line of anastomosis in 4, and about 1 cm. below the line in 4 (Figs. 8 and 9). Two were ulcer free when killed at eleven months. High gastric acid values were found in 3 dogs which were the only ones subjected to gastric analysis. But since Fauley and Ivy[35] have shown that ligation of the pancreatic ducts generally causes hypernormal gastric secretion, it can be assumed that all the dogs had acid gastric contents. The time of onset of the ulcers can be diagnosed quite positively by the symptoms of the dogs. The dogs dying from ulcer died from two and one half to six months after the operation.

We believe that these results show that the jejunal mucosa of the dog is more

sensitive to the irritating action of the gastric contents than the duodenal mucosa, and that this sensitivity is of greater importance than gastric motor drive, which, however, is shown to be a factor by the experiments cited before (Table I) and by the experiments of Morton.[17]

A VIEW CONCERNING THE GENESIS OF ULCER IN MAN

As a result of the various experimental investigations on the problem of the genesis of gastric ulcer, we hold the opinion that the most common factor concerned in the genesis of gastric and duodenal ulcer in man is pylorospasm due to anxiety, worry, etc.

Pylorospasm operates by augmenting or exaggerating the mechanical and chemical factors normally present during gastric digestion. Pylorospasm by mechanically rupturing a blood vessel causes a hemorrhage into the mucosa which develops into an erosion or an acute ulcer on the digestion of the cells in the region of the hemorrhage. This acute lesion does not heal readily because the pylorospasm causes gastric retention.

Gastric retention augments and prolongs gastric motility which, along with insufficiently masticated or large pieces of indigestible residue, acts as a mechanical irritant (see experimental effect of manipulation of an acute ulcer). The motor drive of the stomach or the force of ejection of chyme is increased (see experimental effect of a small gastroenterostomy orifice). Gastric retention also causes a hypernormal gastric acidity and prolongs the time of contact of gastric contents with the acute lesion which increases the irritating action of gastric contents on the acute lesion.

It is believed that the same factors operate along with mucosal susceptibility in duodenal and jejunal ulcers. The absence of an adequate formation of the alkaline digestive juices to neutralize the hypernormal acid gastric contents and possibly the failure of their regurgitation into the upper duodenum and stomach toward the end of the digestive period may be a contributory factor.

In the dog and possibly in man a third factor (see the other chronicity factors discussed in this paper) is necessary, since pyloric stenosis per se definitely delays the healing of acute lesions but does not result in a permanent chronic ulcer of longer duration than approximately two months.

This opinion is neither new nor original, but is supported by our own evidence and that of others. According to this view, ulcer of the stomach and duodenum in man is primarily due to a disturbance of gastric physiology.

SUMMARY

The following factors as determinants of chronicity of ulcer of the stomach and upper intestines have been discussed: (1) infection, (2) mechanical effect of food and motility, (3) blood flow and fibroblastic reaction, (4) allergy, (5) nutrition or digestive disturbance, (6) corrosive or irritating action of gastric contents, and (7) mucosal susceptibility.

Experimental evidence is cited which shows that the roughage in or consistency of the diet in the presence of a factor conducive to connective tissue proliferation is conducive to the formation of a chronic gastric ulcer in rabbits.

Experiments have been devised in an attempt to evaluate the mechanical, nutritional, chemical and mucosal susceptibility factors in the etiology of intestinal ulcers following gastroenterostomy. The evidence shows that all these factors operate and that the mechanical, chemical and mucosal susceptibility factors are the most important.

On keeping the mechanical factor constant and varying the chemical factor (the change in the chemical factor leads to some change in nutrition, which could not be avoided in all animals), it is shown that the chemical factor is the most important.

On keeping the nutritional factor constant and by analyzing the chemical, mechanical and mucosal susceptibility fac-

tors, it is shown that the jejunal mucosa is more sensitive to the irritating action of gastric contents than duodenal mucosa.
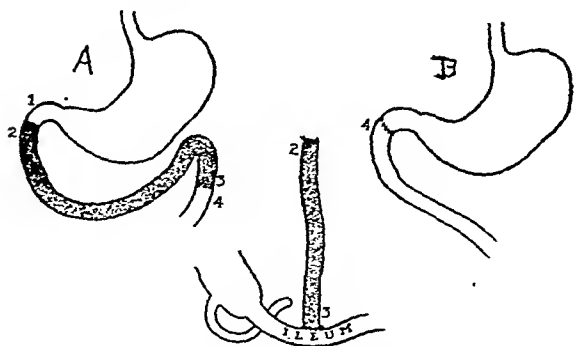
FIG. 12. Duodenojejunostomy with drainage of alkaline juices to lower ileum. A is key to diagram B. 1 is first inch of duodenum. 2 is duodenum at point of entrance of common bile duct. 3 and 4 point in jejunum at which it was sectioned. Ulcers occurred only in jejunum at 4, with incidence of 72 per cent.

The percentage of occurrence of ulcer following various types of gastroenterostomies in the dog shows that the size of the orifice is important and that the jejunal mucosa is much more likely to develop ulcers than the duodenal mucosa.

The results of Mann and Williamson and of Morton on the occurrence of jejunal ulcer, following end-to-end gastrojejunostomy and drainage of the alkaline juices to the lower ileum have been confirmed.

The experimental results on dogs show that for this animal at least a pyloroplasty or gastroduodenostomy is preferable to a gastrojejunostomy, and indicate that if a gastroenterostomy must be done in the human being, a pyloroplasty or gastroduodenostomy is preferable to a gastrojejunostomy so far as the occurrence of postoperative ulcer is concerned.

Our view concerning the genesis of gastric and duodenal ulcer in man has been expressed and briefly outlined.

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DISCUSSION

DR. THOMAS BROWN: I would like to ask Dr. Ivy if he would be good enough to formulate for us his best method of preventing these ulcers, also the best dietetic procedure and the best surgical attack on an ulcer of this variety.

DR. ASHER WINKELSTEIN: I wish to add another to Dr. Ivy's long list of interesting experimental variations. Last year, in some unpublished experiments, Dr. Eugene Klein and I varied the Mann operation in dogs. A duodenoileostomy was performed and the pyloric end of the stomach closed. A side to side gastrojejunostomy was then instituted. Our results tend to confirm Dr. Ivy's findings. Of 5 dogs, only 1 showed a chronic, indurated ulcer; 2 had superficial erosions; 1 had a severe

jejunitis without ulceration; and 1 was normal after sixteen months.

Would Dr. Ivy explain what he means by a nutritional factor? Does he mean under-nutrition due to lack of food absorption in the experimental state of these animals?

Dr. W. L. Palmer: In the discussion of Dr. Ivy's paper there are one or two things to which I should like to call attention. Gallagher of Chicago has been working on the problem of experimental jejunal ulcer following the Mann-Williamson operation and has confirmed the results of these investigators. Gallagher has also produced acute traumatic ulcers by the application of clamps to the jejunum and has found that such ulcers heal spontaneously in from ten to fourteen days. When traumatic ulcers of this type are produced in the jejunum in dogs in whom the Mann-Williamson operation has been performed, the traumatic ulcers, as a rule, heal spontaneously but in 4 animals the traumatic ulcer became chronic. The significance of this has not yet been determined.

Mann has shown that the ulcers which occur following the Mann-Williamson operation begin in the mucosa and extend into the wall of the bowel. This is a significant point for it shows that these ulcers are not embolic or toxic in origin. The process involves the mucosa first and then penetrates the deeper layers.

Dr. Ivy (closing): It is very difficult to feed animals by any other route than by way of the stomach. That is one of the most difficult problems with which we have to deal in our laboratory. When we learn how to keep animals alive indefinitely by feeding through an intestinal fistula, then we can tell the clinician how to feed his cases of jejunostomy.

We were led to do the work on the effect of diet on the healing of acute experimental gastric ulcer because it is pretty well established that the fundamental principle in the therapy of ulcer is to put the stomach at rest as far as possible by starvation and atropine, by frequent feeding of liquids and easily digested foods containing much fat, which in the undigested state inhibits motility and secretion, and by decreasing gastric motor activity by reducing the consistency of the food, omitting roughage and combating pyloro-spasm. Since no one had made an experimental study of the effect of the consistency of the diet on the healing of gastric lesions, we

desired to do so especially since large indigestible particles of food are known to remain in the stomach longer than smaller particles. It is only by such methods as revealed in our experiments that we can satisfactorily prove clinical impressions which not infrequently prove to be facts.

The nutritional factor is evident or operates in animals which lose weight, due to some infectious disease, diarrhea, etc., or in animals in which there is a disturbance of digestion or metabolism such as occurs in bile fistula and pancreatic and bile duct ligation. Defective healing in such animals is manifested by slow healing of skin wounds and the appearance of skin ulcers over bony prominences. The fundamental factor determining why they do not heal well, I do not know. The indication is that these animals are not in a state of normal nutrition and manifest a defective healing response. This disturbance of nutrition has in my experience been associated always with some disturbance of normal digestion.

Now, so far as the treatment is concerned, my view is as follows:

The experimental results on dogs show that, at least for this animal, a gastrojejunostomy is a palliative procedure, and if an operation must be done in human beings for ulcer, or for other purposes, it is certain that a gastroduodenostomy when possible is preferable to a gastrojejunosotmy. You will note that I state, *if* a gastroenterostomy is necessary. It is my opinion that in ulcer, medical treatment should always be tried before an operation is indicated, and operative treatment should be considered as a last resort. Gastric retention due to stenosis is mechanical, a factor to be relieved by operation. The idea of placing the stomach at rest is obvious.

I have been working on the question of ulcer for about twelve years, and I am about to give it up. There are just a few more problems that I want to work out, but there are others that I cannot do, to my own satisfaction, for the simple reason that I know of no way of producing a pylorospasm or reflex nervous disturbance in a dog, as they are known to occur in man, due to emotions, anxiety, etc., with their associated motor and secretory disturbances. This, I believe, is a very important factor in man which I know of no way to duplicate in the dog.

FAILURE OF REABSORPTION OF
GASTRIC AND PANCREATIC JUICE

AS A PATHOGENIC FACTOR IN SOME GASTROINTESTINAL DISTURBANCES*

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CHICAGO, ILL.

UNDER normal conditions, the gastric and pancreatic secretions poured into the upper part of the alimentary tract are more or less completely absorbed in the intestine lower down. Water and inorganic salts, the principal constituents of these secretions, are not appreciably absorbed in the stomach, duodenum, or even upper jejunum. A given quantity of water or salt solution placed in an isolated portion of this part of the digestive tube, may be recovered quantitatively several hours later. In the lower jejunum, ileum and colon, however, the absorption of water and certain inorganic salts may be readily demonstrated by this method. It is clear then that for reabsorption, the gastric and pancreatic juice must be carried by the motor activities of the intestine into the ileum and colon. Interference with this transport or failure of absorption after reaching there must result in the loss of the various constituents of these secretions to the body either through vomiting, accumulation in the lumen of the non-absorbing portions of the tract, diarrhea, or escape through a fistulous opening. The conception that harm might result from the failure of reabsorption of gastric and pancreatic juice has come about largely through experimental work on the pathogenesis of high intestinal obstruction. The loss of gastric juice has been offered as a very attractive explanation for the hypochloremia, alkalosis, and dehydration that accompany obstruction at the pylorus. Such a theory necessarily assumes that the gastric glands and the pancreas can separate the elements for their respective secretions from the blood plasma, when these elements are reduced below their normal concentration. It furthermore assumes that these glands can continue this separation of essential constituents from the altered blood plasma until the latter becomes so abnormal that life cannot further exist. The mechanism for maintaining a constant composition of the blood upon which life depends would then be subordinate to the mechanism for manufacturing a digestive juice. The question involved is of such general physiological importance and in addition is of such practical significance in all conditions where gastric juice does not pass into the lower intestine, that it seemed highly desirable to subject the problem to a crucial test.

It was of course necessary to provide for the continuous total loss of gastric secretion under conditions otherwise as nearly normal as possible and in which obstruction in any part of the alimentary tract was not present. Recourse was made to the following type of preparation. The vagus nerves were carefully separated from the lower end of the esophagus below the diaphragm. The esophagus was then sectioned at the cardia, and the cardiac end of the stomach infolded and closed. The duondeum was cut across just distal to the pylorus and an end to end anastomosis made between the esophagus and the duodenum. A special gold plated cannula was introduced into the pyloric end of the isolated stomach and brought out through a small stab wound in the abdominal wall. The cannula made possible the formation of a very tight fistula and prevented the excoriation of the adjacent skin so troublesome with the customary types of gastric fistulae. The vagus nerves, which carry the secretory fibers to the stomach, were in this

TABLE I
SHOWING THE EFFECT OF THE TOTAL LOSS OF GASTRIC JUICE ON THE BLOOD CHEMISTRY
(Dog No. 1 A)

Days	Remarks	Gastric Juice				Blood Chemistry						
		Vol.	Free HCl	Total HCl	%Cl	Cl	CO₂	pH	Urea N	NPN	Hb	RBC
1	Normal control period...................	....	....	....	....	208	41	7.30	13	27	15.5	5.6
2	Operation production of isolated stomach..	....	....	....	....	261	55	....	14	27		
3	Ringers sol 900 cc.....................	600	0.40	0.43	0.44	210	53	....	14	33		
7	Ringers 1870 cc.....................	1365	0.44	0.47	0.56	261	48	...	13	24	15.4	
8	Ringers 2000 cc.....................	440	0.37	0.40	0.53	280	63	7.31	16	27		
9	No ringers......	190	0.23	0.55	0.58	208	75	....	13	34		
11	No ringers...................	242	0.22	0.20	0.47	171	76	....	27	53		
14	2000 cc ringers daily for 3 days..........	315	0.43	0.46	0.52	262	68	....	13	32		
25	2000 cc ringers daily for 6 days..........	432	0.44	0.47	0.49	268	43	....	10	38		
26	No ringers sol...................	368	0.41	0.45	0.49	220	93	....	16	35		
27	No ringers sol...................	313	0.35	0.38	0.49	151	108	....	37	60		
28	No ringers sol; severe depression........	120	0.31	0.36	0.45	108	104	7.70	60	88		
29	600 cc of 5% NaCl by stomach tube......	238	0.36	0.43	0.48	145	120	....	46	81		
36	2000 cc ringers daily for 7 days..........	660	0.48	0.51	0.55	279	60	....	27	45		
47	2000 cc ringers daily for 11 days........	815	0.48	0.52	0.57	266	70	7.63	20	39		
48	No ringers sol...................	415	0.47	0.50	0.52	208	97	7.57	29	52		
49	No ringers sol....	260	0.40	0.45	0.40	183	108	....	49	80		
50	No ringers sol...................	122	0.33	0.46	0.50	177	114	7.95	9	90		
51	No ringers sol...................	250	0.35	0.42	0.53	110	120	7.73	65	80		

preparation preserved and it is probable that this fact accounts for the greater secretory output observed in these experiments over that reported by Lim, Ivy, and McCarthy[1] using a similar isolated stomach but to which the vagi had been cut.

After such an operation, it is obvious that all of the gastric secretion will be permanently drained away but there is present no element of obstruction. Food after being masticated and ensalivated passes directly from the esophagus into the upper end of the duodenum. It is probable that the secretory function of such an isolated stomach is not greatly below the normal. The nervous or reflex phase of gastric secretion, depending upon the sight, smell and taste of food is not interfered with, or is the chemical phase, at least that part of it brought forth by the presence of food in the intestine. The mechanical effect of food distension in the stomach which is a part of the normal mechanism of gastric secretion (Ivy) is here absent and no doubt for this reason the output of the gastric gland under normal conditions is even greater than observed in these experiments.

To date 6 dogs have survived the operation as described here and studies have been made of the blood chemistry, water and salt intake, urinary and gastric juice output, and general condition of the animal for long periods. A number of interesting facts have been observed, the details of which will be reported elsewhere. It is sufficient to record here that these animals secrete a large amount of gastric juice (600 to 2600 c.c. per 24 hours) of high acidity (0.35 to 0.45 per cent hydrochloric acid) which may be collected in rubber receptacles attached to the fistula. Perhaps this fact may be emphasized here for those who, in their desire to perfect treatments for gastric lesions by the principle of rest, do not realize that the introduction of food into the duodenum causes a copious secretion of gastric juice of normal acidity. Accompanying this secretion there occurs a profound change in the blood chemistry, an exaggeration of the alkaline tide observed after eating. These changes are illustrated by the data in Table 1 taken from one of the experiments. There is a profound fall in the concentration of blood chloride, an increase in the carbon dioxide

combining power of the plasma, a shift in the pH toward the alkaline side, and a late increase in non-protein and urea nitrogen. The animal recovers promptly from the immediate effects of the operation and for two or three days may appear in good condition. Finely ground lean meat and water are supplied ad libitum and are taken in small amounts at frequent intervals during the day and night. The stools are formed and undigested meat particles are not commonly seen. From the time of the operation, however, the dog loses weight steadily. After two or three days an anorexia appears, he refuses food and water and becomes progressively more weak and depressed. The tissues seem to melt away, the weight loss in twenty-four hours ranging from one-tenth to one-twentieth of the total body weight. And yet during this period large volumes of highly acid gastric juice are constantly secreted by the isolated stomach. Death occurs to the weakened, greatly emaciated animal in five to eight days. The picture is that of profound depression. The changes in the blood chemistry are roughly proportionate to the severity of the symptoms, and both are without question due to the removal or loss of gastric juice. The large amount of chloride in gastric juice is well illustrated in Table 1 where it is shown that from 1 to 4 gm. of chloride (calculated as chlor-ion) may be removed from the body by way of the gastric juice in twenty-four hours. A calculation of the total amount of chloride in the circulating blood from estimates of the total blood volume by the dye method indicates roughly that more than three-fourth of the total chloride lost are removed from the tissues and less than one-fourth from the blood plasma. The increase in CO_2 capacity results from this excessive loss of chloride since a large amount of sodium is left in the blood plasma free to combine with CO_2 furnished in metabolism. The extreme alkalosis, as measured by the large increase in the pH of the plasma from 7.30 to 7.95, is an index of the breakdown of the normal

mechanism for maintaining a constant blood reaction in the presence of this continuous large removal of acid radicles from the blood and tissue fluids. The increase in the concentration of non-protein and urea nitrogen in the blood occurs simultaneously with the decrease in urinary secretion. It is significant that this can be brought about by the simple failure of reabsorption of gastric juice without any element of obstruction in the gastro-intestinal tract and with a type of preparation that reasonably excludes the existence of a toxemia of intestinal origin. It is unnecessary to postulate the presence of an intoxication of endogenous origin. It is very probable that this increase in non-protein nitrogen and urea N in the blood is simply due to failure of excretion by the kidneys, although our experiments do not preclude the possibility that a part may be due to the increased breakdown of body protein as suggested by the experiments of Whipple and his associates.[2] We have to date obtained no evidence of a nephritis and it appears to us very probable that the retention is due to the failure of urine formation in the presence of the extreme dehydration. It is probable that the hypochloremia may play a specific rôle in this cessation of urinary secretion as is indicated by the experiments of Curtis.[3] In this picture, the contrast between the gastric glands and the kidney is striking. The gastric gland continues to separate water and salts from the already depleted body fluids while the kidney acting to conserve body fluid in maintaining a normal physico-chemical structure of the blood, stops secreting almost entirely. The ensuing retention of toxic nitrogenous waste products probably counteracts this otherwise beneficial function of the kidney.

The extensive weight loss is probably an expression of severe dehydration, although as mentioned previously we unfortunately at present have no data by which we could compute what part might be due to breakdown of the tissues themselves. Animals have frequently lost from

,500 to 700 gm. in twenty-four hours and at death a total of more than one-half of the original body weight. The large loss of weight in twenty-four hours is chiefly due to the removal of water in the gastric juice. The blood volume, however, remains constant until just before death and in several experiments no evidence of increased concentration of the blood has been obtained. The water removed must therefore come largely from the tissues. We have here again a good illustration of the capacity of the organism to protect the structure of the blood, the physiological homeostasis of Cannon. Water passes into the blood vessels from the tissues to compensate for that removed by the gastric glands. The mechanism which brings this about is largely obscure. After five or six days of total loss of gastric juice, the dehydration of the tissues is extreme, as evidenced by the large loss of body weight (one-fifth to one-fourth of the total), the loss of tissue turgor, the shrunken eyeballs, and general emaciation. It is remarkable that such an animal does not attempt to replace the lost fluid by drinking, since he has at all times free access to unlimited amounts of water. Apparently thirst is related not so much to actual dehydration as to a disproportion between the total amount of water and dissolved electrolytes in the body. Furthermore water alone given by stomach tube or as 5 per cent glucose solution given intravenously will not relieve the dehydration. It is immediately excreted in the urine.

If, when it is apparent that the animal is soon to die from the continued loss of gastric juice, it is given 0.9 per cent NaCl or Ringer's solution intravenously in adequate amounts, it promptly recovers, begins to eat and drink in normal fashion, and the blood chemistry returns toward normal values. By the daily intravenous injection of from 2000 to 3000 c.c. of Ringer's solution, we have been able to keep such animals alive for from sixty to seventy-five days. Apparently, then, the essential substances removed in the gastric juice are contained in NaCl solution. The

inefficacy of water alone indicates the importance of the Na and Cl ions. The intravenous salt solution not only corrects the abnormal changes in the blood chemistry but it likewise relieves the tissue dehydration. Loss of weight is prevented by such injections or if it has already occurred may be replaced. This clearly indicates that the ability of the body to hold water depends upon its content of electrolytes, a view emphasized recently by the illuminating writings of Gamble.[4]

The experiment proves conclusively that the simple loss of the gastric juice from the body causes death in a few days. The outstanding changes are extreme hypochloremia, severe alkalosis, and tissue dehydration. These develop simultaneously and are an index of the abnormal structure of the body fluids when life ceases.

During the course of our work on the effect of the total loss of gastric juice, the report of Elman and McCaughan[5] on the fatal effect of the loss of pancreatic juice appeared. We have, however, continued the original program and have secured data on the effect of the total loss of pancreatic juice by a new method which in large part substantiates and extends the conclusions of these investigators. Large female dogs were selected for the experiments. The duodenum was cut across at the pylorus and again about 8 cm. lower down just below the entrance of the lower pancreatic duct. The pyloric antrum was resected and the lower duodenum anastomosed to the open end of the stomach by end to side suture. The common bile duct was sectioned near its entrance into the duodenum and implanted into the stomach. The upper section of duodenum containing the entrance of the pancreatic ducts was converted into a closed sac by inversion and closure of both ends. An external fistula of this duodenal-pancreatic sac was then established by means of a gold-plated cannula similar to that used in the stomach. By this means a tight fistula was formed and no digestion of the adjacent skin occurred. Pancreatic juice was collected in rubber bags attached to the

cannula. The juice was of course activated by the admixture of a small amount of succus entericus from the mucosa of the duodenal sac.

The dogs recovered promptly from the immediate effects of this rather extensive operation and were permitted to drink milk and water and eat ground lean meat after forty-eight hours. Thereafter during the course of the experiment food and water were permitted ad libitum. A careful daily record was kept of the amounts of food and water taken, the urinary output, the pancreatic secretion, the body weight, and certain features of the blood chemistry. To summarize briefly, the outstanding findings were these. The volume of pancreatic juice collected from such a preparation varied from 500 to 1400 c.c. per twenty-four hours. It is estimated from former studies on duodenal secretion that from 10 to 30 c.c. of this may be succus entericus. This large volume of pancreatic juice secreted per day is an index of the efficiency of this type of fistula and it probably represents almost the normal output of the pancreas. The ducts are not interfered with and even after several weeks, the pancreas shows no evidence of infection. It is quite evident that most estimates of the normal volume of pancreatic as well as gastric juice are far too low. Accompanying this secretion, there occurs a characteristic change in the chemistry of the blood, in some respects opposite to that following the loss of gastric juice. There is a pronounced decrease in the concentration of fixed base, to a less extent a decrease in chloride, a marked decrease in the carbon dioxide combining power of the plasma, and a shift in the pH toward the acid side. The animal loses weight steadily and progressively and becomes rapidly weak and depressed. Death occurs within five or six days. The outstanding changes are severe tissue dehydration and acidosis. That death is due to the continuous removal of pancreatic juice is indicated by the fact that the daily intravenous injection of Ringer's solution or physiological salt solution greatly prolongs life and in part corrects the altered blood chemistry.

It is thus very evident that the property of the gastric and pancreatic glands whereby they can remove inorganic elements from the blood plasma until death is produced makes it necessary that their secretions pass into the absorbing portions of the intestine and there be returned to the blood. Under normal conditions of course this occurs. It is likewise readily apparent that such factors as profuse persistent vomiting and gastric or high intestinal fistulae will prevent this reabsorption. A recent case of gastrocolonic fistula following the perforation of a gastrojejunal ulcer into the transverse colon showed changes in the blood chemistry similar to those obtained in the experimental animal. This patient had a severe diarrhea and undoubtedly gastric and pancreatic juice was lost in large amounts in the feces. When complete obstruction occurs in the upper intestine, gastric and pancreatic juice are lost because they cannot reach the absorbing bowel. Even in low obstructions, the reflex vomiting accompanying distention of the obstructed segment produces a definite loss of these secretions. There is no question but that this failure of reabsorption of gastric and pancreatic juice is a very important factor in the pathogenesis of ileus and fortunately one that can now be adequately controlled.

It is, however, in the following types of gastrointestinal pathology that I wish to stress the rôle of failure of reabsorption of these digestive juices, namely acute postoperative dilatation of the stomach and paralytic ileus following surgical trauma or in generalized acute peritonitis. It is not within the scope of this paper to attempt any comprehensive survey of the clinical and experimental data and resulting conceptions regarding the etiology and pathogenesis of acute dilatation of the stomach. In a recent paper, I[6] have offered the following interpretation of the etiologic factors in this distressing complication of surgical treatment. During

the course of the operation there occurs a profound stimulation of either visceral or somatic sensory nerves depending upon whether the operation is intra- or extra-abdominal. This produces a profound reflex inhibition of the tonus and motility of the stomach as a result of which it becomes greatly distended by swallowed air and the accumulating secretions of the gastric mucosa. In many cases, although apparently not in all, the dilated stomach forces the intestines into the pelvis and produces a secondary compression of the inferior horizontal portion of the duodenum by the fold of mesentery containing the superior mesenteric vessels. When this occurs, even though the obstruction be relatively slight, the atonic stomach and duodenum are unable to force their secretions into the lower intestine. As a result they accumulate in the non-absorbing dilated stomach and proximal duodenum and overflow into the mouth. They are thus effectually lost to the body and as we have seen, this removal of Na and Cl ions by the stomach and pancreas is entirely adequate to account for the death that occurs in untreated cases with the well-known preliminary dehydration and anuria. In one case of acute dilatation of the stomach that we have observed recently, a profound hypochloremia and increased carbon dioxide combining power of the plasma, together with elevated NPN and urea N were found (Dragstedt and Ellis).[7]

In acute generalized peritonitis likewise this failure of reabsorption of gastric and pancreatic juice must be considered as a major pathogenic factor. That hypomotility to complete atony of the gastro-intestinal tract exists in this disease is of course well known. It seems probable that this is due partly to the direct action of bacterial toxins on the intestinal wall but to a greater degree to reflex inhibition from the irritated and inflamed peritoneum. It is easy to demonstrate such a viscero-visceral reflex in a cat under light ether anesthesia or after decerebration. Stimulation of the parietal or visceral peritoneum by traction or electrical stimulation

causes complete inhibition of the movements of the stomach and intestines. This is partly prevented by previous section of the splanchnics. Gastric and pancreatic juice not being propelled down into the lower jejunum, ileum and colon accumulate in the non-absorbing stomach and upper intestine and are lost by regurgitation or vomiting. It is therefore not surprising to find in acute peritonitis those changes in the blood chemistry which we have found to result from the simple uncomplicated loss of gastric and pancreatic juice. The profound improvement occasioned by the administration of large quantities of physiological salt solution or Ringer's solution in these patients is an index of the significance of this factor in the pathogenesis of the disease.

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DISCUSSION

Dr. Stanley Dorst: I would like to ask the essayist whether or not he has had any experience with experimental ligation of the esophagus in dogs. Andrus and Guest in Cincinnati have been doing some very interesting experimental work along this line and are describing results often quite analogous to those following high obstruction of the intestinal tract when the esophagus alone is artificially obstructed.

Dr. Portis: I should like to ask Dr. Dragstedt if I understood him correctly in saying that there are no renal changes in the dogs whose stomachs have been operated on in the manner described, and if this is true, how does he correlate these findings with the renal changes in patients suffering from alkalosis?

Dr. Brown: I would like to ask Dr. Dragstedt if he regards this condition as being due

to a lack of the absorption of the stored materials or due to the lack of iron in the blood. I would also like to ask him if he has been able to prolong the life of these animals by large doses of bicarbonate of soda.

DR. SMITHIES: In 2 cases, recently, one of central ileus and one due to peritonitis, I have noted the presence of tetany. In this paper there are certainly some important practical points in regard to treatment, and it seems that some real progress has been made. At least, I hope so.

There are minor evidences of this syndrome, at times, it seems to me, in the over-alkalinization treatment of ulcer. We forget, sometimes, when we alkalinize that we are introducing a foreign body, our object, of course, being the neutralization of the acid by alkali. The stomach attempts to maintain its normal relations, i.e., an acidity, and sometimes over-secretes. Then there is another class of case, where there has been a gastrojejunostomy, accompanying it with a relatively high ileus. In those cases, we often see changes in the jejunum and duodenum, without changes in the blood content.

DR. ASHER WINKELSTEIN: To one who is particularly interested in the physiology of gastric secretion, Dr. Dragstedt's paper is very important. It may not be necessary to assume that the large amount of secretion from the isolated stomach is due to a combination of vagus nerve and intestinal stimuli. For, inasmuch as the stomach is still within the body in these experiments, is it not possible that the second, chemical, or antrum phase of secretion is being produced through the medium of the blood stream?

I should also like to know if Dr. Dragstedt found inflammatory, especially ulcerative lesions, in the isolated stomachs? In some experiments cited in Von Redwitz's book on the pathogenesis of ulcer, large ulcers were found in stomachs isolated in the same manner. Such lesions, if present, would also help to explain the large amounts of gastric secretion occurring in these experiments.

DR. MYER: I think that this very brilliant piece of work from Dr. Dragstedt is a very brilliant illustration of the value of that experimental work on animals which has been carried on throughout the country for several years, as well as abroad. It seems to me that this brings out many clinical and physiological factors that could never be brought out in any other way, and there are certainly a great many analogies that we can draw from work of this sort. I don't think that I have ever seen figures for the hydrogen ion content of the blood, or its concentration, that are as high as Dr. Dragstedt has given here.

Some years ago B and his associate brought out a series of studies on hyperemia(?) in which they got results that were somewhat comparable to these. I think that their work did not bring out such high figures; certainly the figures that Dr. Dragstedt has reported are extremely high.

I should like to know whether any of Dr. Dragstedt's animals showed symptoms of tetanus. Dr. Goldstein reports that his subjects went into tetany, and I wanted to get that straight in Dr. Dragstedt's paper. Also, if there was an alkalosis. I should also like to know about the possibility of withdrawing both the gastric and the pancreatic secretion. The pancreatic secretion has a detoxifying action and if you remove one factor in this chain, you spoil the balance of the whole.

We are, therefore, entitled to say, that if there is ever any danger lurking to any organ within the peritoneal cavity, the omentum wanders out to it and protects it. For this reason it deserves to be called the "policeman" of the abdominal cavity.

Whether this means "automotive power" or "attraction" deserves to be decided definitely at the laboratory.

DR. DRAPER: To me, this is an extremely important contribution. I have been interested in the cause of death from such obstructions for a great many years, and it seems to me that the work of Dr. Dragstedt has advanced the problem very much.

I did note, while working on dogs, that death occurs from obstruction of the esophagus, and I, therefore, question whether the problem is entirely answered as yet, because it does not seem that esophageal obstruction would interfere with the progress downward of the gastric secretion.

I should like to know whether Dr. Dragstedt has ever considered if the use of the term "dehydration" is desirable. Some years ago Dr. Hartwell did some very interesting experiments in regard to dehydration as the possible cause of death in obstruction. In order to check the experiment, I gave pilocarpine to various animals and found that we could, apparently without damage to the animals cause dehydration of the important abdominal and

muscular tissues to a greater extent than was observed to be present in the tissues of dogs dying from acute duodenal obstruction.

Finally, I should ask Dr. Dragstedt whether he has made further studies in regard to actual dehydration, and, if so, by what method. I feel that this is a very important matter, because there is no doubt, in my mind, at least that there is a close relation between partial obstruction of the intestinal tract particularly in the duodenum and many serious neuromuscular and perhaps, psychotic, disturbances in man.

Dr. Dragstedt (closing): I should like to emphasize that I do not believe that this failure of reabsorption of the digestive juices is the sole factor in the cause of death from acute intestinal obstruction. It is probably the most important factor in high intestinal obstruction but we have definite and quite conclusive experimental evidence that a toxemia of intestinal origin plays a rôle particularly in obstruction in the lower jejunum, ileum and colon. It is in these latter cases that distention of the obstructed intestine is marked and it is this distention that makes possible the absorption of toxic materials from the bowel lumen.

I am very grateful for the interest manifested in this investigation but I fear that time will not permit my answering all the questions. With regard to the relative significance of the ferments and the inorganic elements in the digestive juices, the evidence clearly indicates that it is the loss of the latter and in particular of the sodium and chloride ions that causes the rapid death under the conditions of these experiments. The cause of death in esophageal obstruction is still obscure. It is however obvious that there is no loss of gastric or pancreatic juice in this case. The suggestion that death is due to the failure of reabsorption of saliva is hardly compatible with the fact that animals may live for months with complete salivary fistulae or indeed an upper esophageal fistula as in the sham-feeding experiments of Pavlov. Some unpublished experiments by C. A. Dragstedt indicate that many dogs with esophageal obstruction die from pneumonia and other pulmonary complications.

When death occurs from the failure of reabsorption of gastric juice, the outstanding changes observed are hypochloremia, alkalosis, and tissue dehydration. It is not possible at present to say which of these conditions is the lethal factor. They all occur simultaneously and are an index of the abnormal state of the body fluids when life ceases. The dehydration produced by the loss of gastric juice is somewhat different from that caused by profuse sweating or the withholding of water. In the latter case the inorganic elements in the body fluids tend to become concentrated. Gastric juice on the other hand contains approximately the same concentration of inorganic ions as the blood plasma and its removal accordingly does not leave an increased concentration of inorganic ions in the body fluids. As an illustration, the removal of 500 c.c. of normal salt solution from a flask containing a liter, does not alter the concentration of what remains although the quantity is less. It is probably for this reason that the dogs do not drink although they have free access to water. Thirst may be related more to the concentration of inorganic elements in the body fluids than to the total amount of water in the body.

We have watched our animals very carefully for symptoms of tetany or nervous hyperexcitability in view of the extreme alkalosis. To our surprise no tetany has been observed, the deviation from the normal being in every case in the direction of depression.

The mechanism which induces gastric secretion in our animals with the isolated stomach is doubtless twofold. The integrity of the vagi permits of the reflex stimulation of the gastric glands through vagus secretory fibers. The presence of food in the upper duodenum releases chemical substances (gastrine) into the blood stream which in turn stimulate the gastric glands to secrete juice. This factor was clearly demonstrated in Ivy's experiments of a few years ago.

We have to date observed no actual organic changes in the kidneys of animals dying from the loss of gastric juice. It is probable that the increased concentration of non-protein and urea nitrogen in the blood represents a retention of these substances as a result of the extreme dehydration. The contrast between the kidneys and the gastric glands is striking. The kidneys, acting to conserve fluid in view of the extreme dehydration, stop secreting almost entirely while the gastric glands continue to separate water and salts from the blood plasma until death is produced.

LATERO-POSTERIOR INCISION FOR APPENDECTOMY*

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NEW YORK

THE late A. I. Ochsner, in discussing the choice of incisions for appendectomy, wrote:

It is important that the incision furnish ample room to remove the appendix without infecting surrounding tissues: at the same time provision must be made in case an abscess is present to provide satisfactory drainage. The incision should be so planned as to give the greatest guarantee against postoperative ventral hernia. In removing a severely infected appendix during an acute attack too much attention cannot be given to means of preventing infection of the surrounding tissues. One of the most important prophylactic measures lies in reducing traumatism to a minimum. It has been shown conclusively that the surrounding tissues, if not traumatized, will dispose of a large number of microorganisms capable of producing a violent peritonitis if the peritoneum has been bruised by rough handling.[1]

Today we could only improve on the desiderata laid down by Ochsner by adding that we should plan and execute the operation in such a manner as to prevent the formation of preventable postoperative adhesions.

These desiderata cannot be realized with the ordinary abdominal incision. Traumatizing of tissues, spilling of purulent infective material, postoperative ventral hernia, postoperative adhesions, of necessity follow the long, tortuous abdominal route.

The author proposes a new incision which fulfills all the desiderata even in the most difficult cases, that is, when large retrocecal abscesses are present. The author's incision, which could be called latero-posterior, runs parallel to the axillary line: begins, according to the thickness of the panniculus adiposus, more or less close to the twelfth rib and is extended to the pelvis; it runs about 2 cm. behind the anterior superior iliac spine. This incision (Fig. 1) exposes first the fascia of the external oblique, then in succession the external oblique itself, the internal oblique and the transversalis. The fibers of these muscles, which cross each other, are simply separated, *not incised*. The peritoneum is incised parallel to the skin incision, thus exposing the cecum (Fig. 2). Two retractors are applied: the upper one should only hold back the tissues enough to expose no more than the middle of the cecum; the lower should be pulled down sufficiently to expose the posterior peritoneum. The cecum is grasped either between the left index and the thumb (Fig. 3) or with a soft clamp covered with rubber and gently pulled upward in order to expose the base of the appendix.

The easy and complete exposure of the base of the appendix is one of the most important advantages offered by the latero-posterior incision. The appendix may wander anywhere in the abdomen, but its base is always to be found at the cecum. When the base is located, finding and removing the appendix, without traumatizing the surrounding peritoneal organs, becomes an easy procedure. In fact, through the latero-posterior incision one could almost say that the appendix is removed without actually entering the general peritoneal cavity. It is snatched from behind the cecum, without exposing or touching any other organ.

Figure 1 shows plainly that when the abdominal route is chosen the surgeon has to travel through the whole thickness of the abdomen, and push away other organs before he can reach the appendix and its base, while with the latero-posterior incision he reaches the cecum with the base of the appendix directly without meeting any other organ.

[1] A Treatise on Regional Surgery. Vol. 2, pp. 177 and 181.
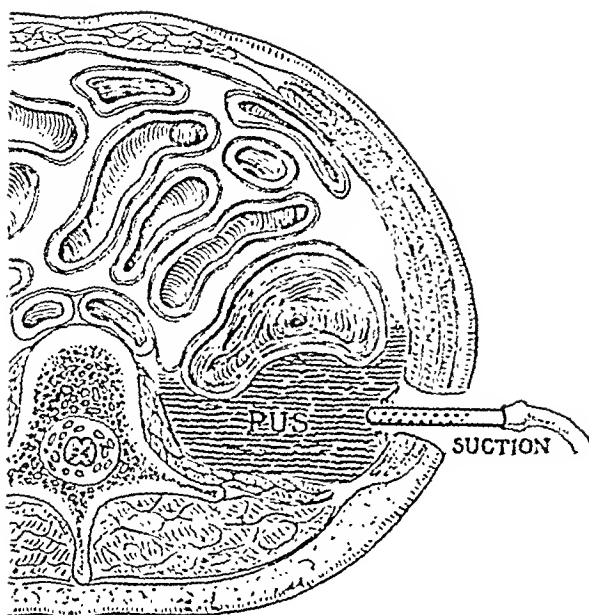
FIG. 4. Diagrammatic view of how a large purulent collection can be evacuated through the latero-posterior incision without spilling pus into the general peritoneal cavity: through the usual abdominal incision, instead, the general peritoneal cavity must of necessity be more or less contaminated and infected.

FIG. 5. Diagrammatic view of modified Mikulicz drainage: the modification consisting in putting in contact with the peritoneal organs a layer of paraffinated gauze: this prevents the formation of adhesions of the gauze itself to the cecum and parietal peritoneum.
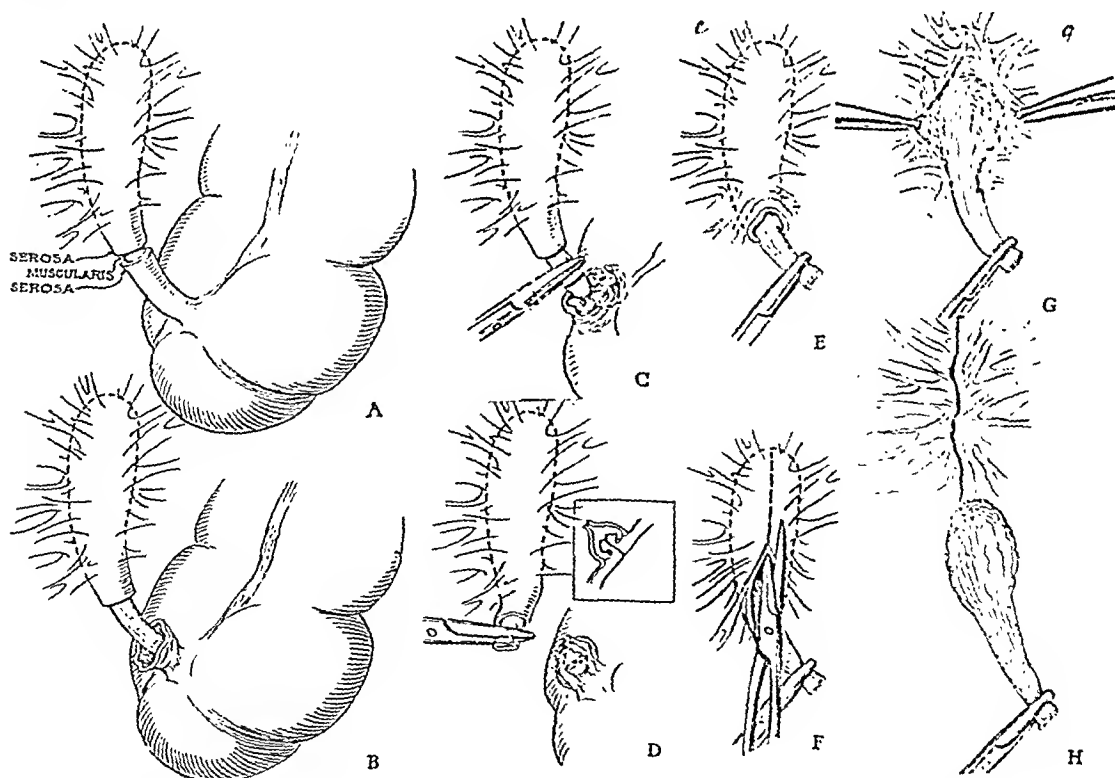
FIG. 6. Different steps in subserous appendectomy: serosa is incised circularly about 2 cm. from base, A; serosa is pushed back towards base, B; appendix is tied close to cecum, clamped above ligature and severed between tie and clamp, C; stump is covered with cuff of serosa, D; serosa is separated from appendix, E; serosa is cut with scissors if appendicular abscess is present at tip of appendix or for any other reason tip is too large to pass through cuff of serosa, F; appendix is shown free from serosa after incision of the latter, G; appendix freed from serosa and surrounding adhesions which have thus not been disturbed, H.

General Peritonitis. The desideratum so ably expressed by Ochsner of "reducing traumatism to a minimum"* seems too

Fig. 7. How appendix may be freed from adherent structures without causing trauma by the subserous method and through the latero-posterior incision.

these organs are not even disturbed. The pus is easily evacuated through the suction cannula. If drainage is desired, nothing is easier than to apply a Mikulicz drain or place whichever drains are preferred wherever they are deemed necessary, with the certainty that drainage will be ideal, being accomplished by gravity, especially if the patient is placed in the latero-oblique position as shown in Figure 8.

Adhesions. Adhesions may render appendectomy very difficult and very dangerous quantum vitae and quantum postoperative complications. With the abdominal incisions the base of the appendix is reached only after loops of intestine, omentum, and at times the parietal peritoneum are severely traumatized. The difficulties met when adhesions are present and the dangers caused by their existence are too well known to be insisted upon. When the latero-posterior incision is used, adhesions are not a serious complication, they do not render the operation more difficult or more dangerous. In these cases we advise the surgeon to resort to subserous appendectomy, well illustrated in Figure 6, which has the following advan-

SIDE VIEW   FOOT-END VIEW

Fig. 8. Position to be given to patient in order to favor latero-posterior drainage.

A: Lowest point.
C: Highest.
B and D: Intermediate.

modest now that we can use the latero-posterior incision. There is not only no traumatism of the peritoneal organs but

Loc. cit.

tages: it does not break up inflammatory adhesions, which bleed and later cause denser adhesions; it allows the easiest removal of the appendix; it is more easily

performed when the appendix is inflamed, the serosa peeling off as easily as the skin of a banana. Figure 7 shows clearly how a subserous removal of the appendix done through the latero-posterior incision does not require breaking of adhesions and damaging peritoneal organs. Subserous appendectomy is easy even when an appendicular abscess is present.

Prevention of Usual Complications by the Latero-posterior Incision. Drainage is ideal, so that complications due to poor drainage may become a thing of the past.

Postoperative Ventral Hernias. With the latero-posterior incision three muscles, the fibers of which cross each other, are met. The separated muscular fibers have a strong tendency to resume their natural position, thus closing securely the gap created at the time of the operation. In 2 cases of general peritonitis, in which a modified Mikulicz was applied, the abdominal wall became exceptionally solid: in fact as solid as in the cases in which no drainage was used.

Spreading of localized peritonitis becomes a practical impossibility.

Loss of life due to general peritonitis should be decreased considerably, because the appendix can be removed without traumatizing other peritoneal organs; pus can be evacuated and drained most effectively; the shock of the operation is considerably decreased; *chronic fecal fistulas* should be a thing of the past; the cecum closes very easily when drained posteriorly, as can be effectively done when appendectomy is performed through the latero-posterior incision. In 1 case in which a thickened cecum could not be closed effectively the fecal fistula lasted only twelve days.

Postoperative Adhesions. The worst and most feared complication of appendectomy, that is postoperative adhesions, should become a thing of the past. The general peritoneal cavity never needs to be entered even when inflammatory adhesions or abscesses are present. The cecum is the only organ that may become adherent after the operation. Even when such adhesions occur they do not cause any trouble, because the cecum becomes adherent to the latero-posterior peritoneum, which is not an abnormal condition.

CONCLUSIONS

The author has described a latero-posterior incision for appendectomy, which permits the surgeon to reach directly the base of the appendix and the whole appendix. This incision renders appendectomy easier and safer in the presence of the most severe complications, such as retrocecal appendix, appendicular abscess, adhesions, general peritonitis. It decreases shock because no other peritoneal organ except the cecum is disturbed or traumatized; it does not require any packing; it requires very little retraction; it is speedier than through any other incision. It allows perfect drainage. It does not cause any postoperative complications, such as adhesions, ventral hernia, or chronic fecal fistulas. It can be done easily under local, spinal, or gas anesthesia even when the patient is restless, or not completely relaxed, because loops of intestine cannot protrude through the incision.

Pus situated in a localized abscess can be evacuated without infecting the general peritoneal cavity.

When general peritonitis is present it allows the most ideal conditions for shockless, traumaless operation and perfect drainage.

The author describes and advocates a technique for subserous removal of the appendix which renders appendectomy safer, easier and speedier even when dense adhesions are present.

Patients are more comfortable after an appendectomy performed through the latero-posterior than through any other incision.

Dulcis in Fundo. This incision is ideal only for appendectomy: it is not meant for exploratory laparotomies.

THE SPINAWL FOR SPINAL ANESTHESIA*

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THE skin of the back is thick and tough. This makes it difficult to use a needle of small caliber for lumbar

FIG. 1.

FIG. 2.

FIG. 3.

puncture unless a preliminary opening is made in the skin.

The instrument illustrated, an awl for spinal use, has a triangular point with sharp cutting edges like a skin needle. It is easily inserted and leaves a tiny opening through the skin. The top is slightly cupped and measures ⅞ in. by ⅞ in. The pin is 1¼ in. long and tapers from top to bottom. The shape of the instrument makes it easy to control and direct.

Our procedure is as follows: The skin is anesthetized with novocaine and ephedrine solution, using a small hypodermic needle; the spinawl is then used to make a small puncture in the way illustrated. Then, without removing the fingers of the left hand, the hollow spinal needle introducer is inserted and its stilet withdrawn. Through this a small caliber spinal needle, with short bevel, is passed into the spinal canal. The whole process takes less than a minute and, in our experience, greatly shortens and facilitates the induction of the average spinal anesthesia.

* Submitted for publication January 16, 1931.
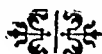
TUBERCULOSIS OF THE UTERUS AND TUBES*

Arthur M. Dickinson, m.d., f.a.c.s.

ALBANY, N. Y.

TUBERCULOSIS of the female genitalia was first described by Morgagni. It is generally a secondary or descending infection although cases have been reported in which the infection was thought to be primary or ascending. Ordinarily infection takes place through the blood stream from some distant focus or through the lymphatics from a nearby focus. Occasionally it occurs by direct extension from neighboring structures. Genital tuberculosis in the female is usually preceded by trauma of some sort such as parturition or infection with the gonococcus. It is stated that 20 per cent of tuberculous lesions in the female involve the genitals. In many instances, tuberculosis of the genitals is difficult of diagnosis and is only suspected in light of a recognized tuberculous lesion elsewhere, such as a pleural or pulmonary one.

The uterus is involved in about 40 per cent of the cases of tuberculosis of the female genitalia. Ordinarily only the endometrium is affected but in more advanced cases, the uterine muscle may be invaded. Tuberculosis of the uterus is usually associated with tuberculosis of the tubes which probably explains its more common occurrence in the region of the cornua. The lesions may be either miliary or caseous in type. The symptoms of tuberculosis of the uterus are often masked by those of the original focus. There may be pelvic pain and discomfort, leucorrhea, menstrual irregularities, dysmenorrhea, etc. Diagnosis depends upon microscopic examination of the curettings obtained. Treatment consists of hysterectomy if lesions elsewhere are such as to justify hope of arresting the disease.

Tuberculous involvement of the tubes occurs in about 90 per cent of the cases of female genital tuberculosis. Ordinarily the process begins in the tubes and then involves the uterus or ovaries secondarily. The systemic focus is usually located in the lungs. Tuberculosis of the tubes occurs most frequently during the period of sexual activity and in those tubes previously damaged by infection with the gonococcus. The onset of the disease may be evidenced by an acute reaction with pain, tenderness and abdominal distension or it may be insidious with vague pelvic symptoms and menstrual disturbances. There is usually demonstrable evidence of a tuberculous lesion elsewhere in the body. The lesion is always bilateral. Later and more chronic stages of the process may present symptoms of bladder and rectal troubles because of adhesions. In some instances there are acute exacerbations followed by long periods of quiescence. The diagnosis is often difficult. The finding of a tuberculous area elsewhere is always suggestive. Treatment consists of removal of the tubes with conservation of the ovaries if they are not involved.

CASE REPORT

V. B., married, aged twenty-two, no children, first came to me on April 1, 1930. She was complaining of nervousness and prolonged menses. She stated that she flowed slightly but continuously except for three or four days of the month. She had worn a napkin almost constantly for two years. There had been no

pregnancy or infection. There was a history of pleurisy with effusion five years previously; this was thought to have been tuberculous but

On May 19, under spinal anesthesia, plus gas and oxygen, a panhysterectomy and bilateral salpingectomy was done. The uterus was
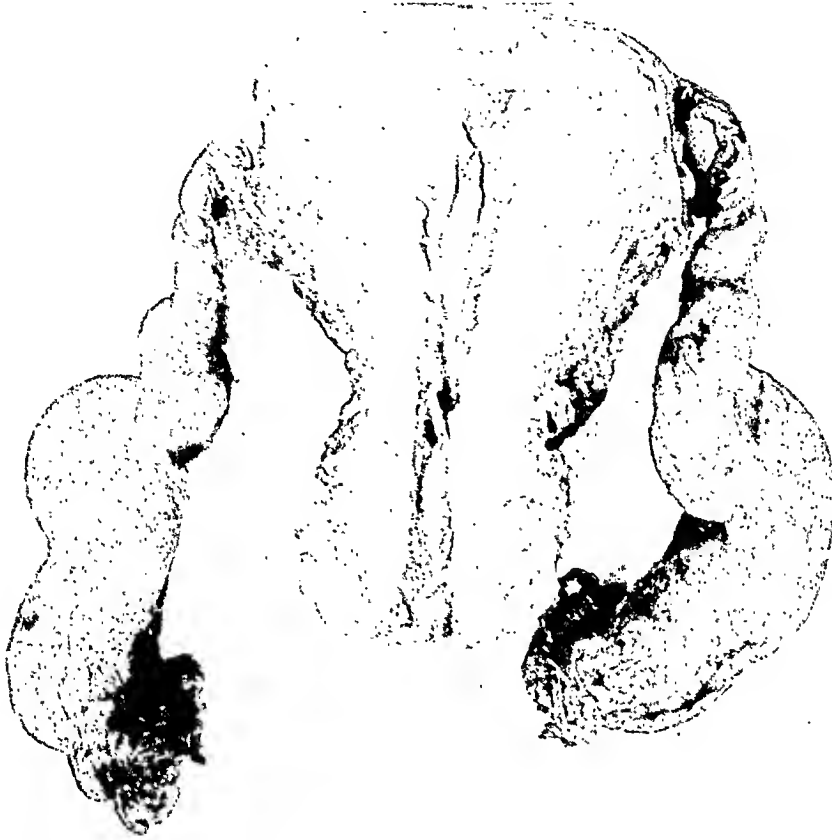
Fig. 1. Specimen of tuberculosis of uterus and tubes. Note involved endometrium which is evident; also swollen and dilated tubes.

not proved so. Pelvic examination was difficult on account of the small introitus but seemed negative. In view of the apparent negative surgical findings, the patient was referred back to her physician for careful examination. Complete examination including radiographs of the chest was made twice with negative results. The bleeding continued and so it was decided to perform a diagnostic dilatation and curettage. On May 10, under gas and oxygen anesthesia, a pelvic examination was made with no positive findings; then the dilatation and curettage were done. The laboratory report on the curettings was tuberculous endometritis.

With a report of tuberculous endometritis, it was deemed wise to perform a hysterectomy.

slightly enlarged but the serosa was smooth and free of any evidence of tuberculosis. The tubes were markedly enlarged and red; they appeared like small sausages. The ovaries appeared negative. The pelvic peritoneum seemed normal; no further abnormal findings were noted. Closure was made by layer suture without drainage. Recovery was prompt and twelve days after operation, the patient was discharged to her home with the wound healed. Four months after the last operation, examination was negative; the patient stated that she felt fine and had gained 6 lb. in weight.

Laboratory examination of the specimen disclosed tuberculosis of the endometrium and of the tubes. A photograph of the specimen shows the uterus opened and tubes intact.

REMOVAL OF A METAL RING FROM THE PENIS*

JOHN E. CANNADAY, M.D.

CHARLESTON, W. VA.

FROM time to time we hear of cases in which a ring or other closely fitting circular device has been placed around
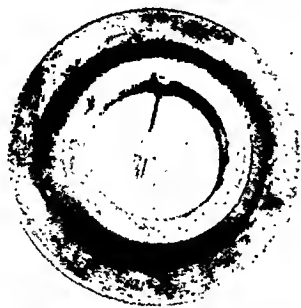
FIG. 1.

the penis. After a short time so much swelling has taken place that the possessor is unable to remove the ring. Some of these instances, no doubt, are the result of boyish pranks, again this has at times been done with the idea of preventing bed wetting. Other cases occur among those having psychopathic or neurotic tendencies, and in some instances rings or other similar devices have been placed on the male organ by practical jokesters while the victim was in a drunken sleep.

The portion beyond the ring swells, the skin immediately under the ring becomes eroded, and about this time the patient usually consults a physician. The ring can usually be removed by cutting it in two at one side and springing the ends apart. Occasionally some hard and highly resistant metal may be encountered, as was the case in the subjoined report.

CASE REPORT

E. M., aged fifteen years, of St. Albans, W.

Va., was admitted to the Charleston General Hospital in a very uncomfortable condition. He gave a history of slipping a bicycle cone over his penis two weeks before admission to the hospital. He was unable to remove it and was ashamed to tell anyone about it. Finally, he became so disabled that he told his mother who called a physician, Dr. T. S. Tompkins, who sent him to the hospital.

On examination he showed an enormous swelling of the penis; the skin was very badly eroded all around the circumference due to pressure of the ring.

It is well known that the cone and other of the wearing parts of bicycles are usually made of vanadium or chrome steel, either one of which is of extreme hardness and is cut with great difficulty. Numerous ineffectual attempts were made to divide this piece of metal with a hack saw, 8 or 10 hack saw blades having been worn out in the course of eleven hours without making any headway at all worth while. It finally was decided that the only possibility of getting off this ring, or cone, was by revers ing the manner in which it had been put on.

Under gas anesthesia, after making multiple punctures in the edematous skin and forcing out the serum, compressing the penis manually and with an Esmarch bandage, we finally succeeded in reducing its size sufficiently to enable us to gradually force it back through the opening in the cone by grasping a portion of the body with a sponge forceps and gradually working it back through the opening. The penis was considerably traumatized in the process but after a few days was apparently restored to normal.

The case is reported merely because the ring could not be removed in the usual manner by dividing and spreading it and to describe a different method of removal of the ring from that usually practiced in such cases.

*Submitted for publication August 10, 1930.

The American Journal of Surgery is truly independent and enters into no "entangling alliances." It publishes many papers read before the leading surgical societies of the Country, but it is *not* "the official organ" of any organization. Every manuscript is selected by the editors, as worthy of publication—nothing is published merely because "it was read at the meeting."

EDITORIAL

OLD AND MOULDY

OLIVER WENDELL HOLMES is credited with saying people wanted their doctors like their cheese—old and mouldy. Recently, we chanced across the fact that most teachers of the various branches of medicine like their textbooks dull and pedantic.

Well do we remember our student days—the books we had to read, digest and memorize . . . most of them cures for insomnia. One stands out different from the rest. It was a book on office gynecology, recommended for collateral reading. This particular book may be described as "human." The author knew how to get his message across and at the same time entertain and interest the reader.. Perhaps this is why we chose gynecology as a specialty.

Someone might make it his hobby to trace out the original model of the modern textbook. Somewhere back in the prefossil age a savant did a book. It became a text for undergraduates in medicine. Since then 99½ per cent of all medical writers have stuck closely to the original pattern. The illustrations and publishers may change but the contents go on forever.

Within recent years a new note in medical writing has been introduced. Without marring one bit the worth of the manuscript; ever keeping the main facts in the foreground, always advancing forward to definite, clean-cut conclusions, but never for a minute becoming dull and commonplace, Walter Alvarez, first in his "Mechanics of the Digestive Tract" and later in his "Nervous Indigestion," stands forth brilliant against an old and mouldy background.

It chanced to come to our attention that a teacher wrote concerning a popular book: "I wish we could make every doctor and medical student in the country read the chapter on organic disease. I am doing my best to get my boys to study it. I fear the book is too entertaining to be introduced as a regular textbook—more's the pity."

We have learned that the head of a department of a western university objected to another publication as a textbook "because the students might read it for pleasure." This might give a clue to one of the many reasons chiropractic, absent treatments, and old Doctor Grindle are in vogue.

Apparently textbooks, like some medicines, must taste vilely in order to be appreciated by certain teachers of medicine.

T. S. W.

SIR ASTLEY PASTON COOPER

[1768–1841]

"COOPER'S FASCIA"

ASTLEY PASTON COOPER of Norfolk was born in 1768. He was a pupil of John Hunter's. It was written he was the most popular surgeon during the first quarter of the century. Bettany said, "No surgeon, before or since has filled so large a space in the public eye."

Cooper's life was one continuous journey along the road of success. Few surgeons since the beginning of time have had so many engravings made of his likeness.

In his early years he had little money and little practice. He married and with his wife came a fortune. Ever after he needed to pay scant heed to an income although his professional earnings were enormous.

He became a demonstrator of anatomy at St. Thomas's Hospital at the youthful age of twenty-one and eleven years later became surgeon at Guy's Hospital (1800).

Cooper was a pioneer in surgery of the vascular system, in experimental surgery, and in surgery of the ear. Early in the century he successfully ligated the common carotid and the external iliac arteries for aneurysms. Years later (1820 and 1826) he made post-mortem dissections of these cases. In 1817 he ligated the abdominal aorta, which would be an unusual feat even today. In 1802 he won the Copley Medal with an account before the Royal Society of this method of perforating the tympanic membrane for deafness resulting from obstruction of the Eustachian tube. He reported the results of 20 cases.

In 1820 he performed a slight operation on George IV and was elevated to a baronetcy.

With all his popularity and success few men worked harder or labored for longer stretches of time. He dissected every day of his life, even when travelling. He paid high prices to the body-snatchers of his time. Once before a committee in the House of Commons he stated that "there was no person, whatever his wordly place, whom he could not dissect if he would."

Cooper had a daily routine. He arose at 6 and dissected until 8, at which time he breakfasted on two hot rolls and tea. He saw poor patients for an hour, attended to his private practice until noontime. He then would drive to Guy's to visit the wards. At 2 P.M. he lectured on anatomy at St. Thomas's Hospital, after which he went through the wards with his students, dissected with them or performed operations until seven. He bolted his meals. After dinner he took a short nap and then lectured, dissected or attended his practice until midnight. He dictated his writings while riding in his carriage. He wrote books on "Hernia" (1804–07), "Injuries of the Joints" (1822), "Diseases of the Testis" (1830), and the "Anatomy of the Thymus Gland" (1832). He is remembered for Cooper's fascia, Cooper's glands, Cooper's hernia, and other eponyms.

Popular, "courteous-eyed, erect and slim," cultured, at ease in all society, he attributed his success to his uniform and unfailing courtesy to rich and poor alike.

Sir Astley died in 1841.   T. S. W.
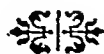
[From Fernelius' Universa Medicina, Geneva, 1679.]

BOOKSHELF BROWSING

FOUR THOUSAND YEARS OF OBSTETRICS*

J. WILLIAM WHITE, M.D.

SCRANTON, PA.

OBSTETRICS is that part of the science and art of medicine most intimately related to the function of reproduction, the foremost of the four primary, instinctive bases of nature. The word obstetrics comes from the Latin *ob* and *stare*, "to stand before," "to protect." While, in the strict sense, it should be applied to childbirth or parturition, usage justifies its application to all phases of human reproduction, with midwifery and tocology as synonyms.

The function of reproduction is a closed cycle of events interposed in the life of woman, and comprised of five periods: conception, pregnancy, labor, lactation and involution, with possibly a sixth, menses, a prerequisite.

The history of obstetrics possesses a peculiar interest, and one by far more general than that of any other branch of medicine as its status and its progress are most intimately blended with the condition of peoples and the extent of their civilization.

The obstetric art, the assistance rendered during parturition, the care of the mother and child, is a necessity at all times. This branch of medicine applies to the physiological as well as the pathological state,

and thus differs from all others the exercise of which is confined to morbid conditions.

However remote the period, however crude or primitive the people, in ancient or modern times, aid was always given child-bearing women. Long before medicine was conceived as an art, women who bore children received attention from the most primitive peoples who, taught by experience, assisted their neighbors as a warrior or hunter renders primary surgical aid to his wounded fellow.

Much information relative to the parturient of the dark age remains conjectural and obscured by mists only dispersed with the advent of the earliest records. It is quite natural to assume, however, that obstetrics was the art first and most frequently called for and that it attained a certain degree of perfection at relatively an early day. It is almost inconceivable that not a step forward was taken for two thousand years, from the time of Hippocrates until Paré and Vesalius laid the foundation for the modern scientific school.

In early days it was woman who gave aid to her sister in child-birth; the art was in the hands of women, usually of low caste. It was looked upon as woman's work, and progress was thus impeded, if

not impossible. While the aid of priests or men thought possessed of mystic powers was sought in difficult cases, they were at other times carefully excluded from the lying-in room, and thus prevented from gathering the experience necessary to progressive innovation. It was eminently the sphere of woman, and so considered until the era of modern scientific medicine. We need but recall the experience of Dr. Wertt, of Hamburgh, Germany, who in 1522, attired as a woman, sought to attend and study a case of labor and was burned alive for his endeavor. We may also recall the experience of Dr. Willoughby one hundred years later, who, while assisting his midwife daughter, was obliged to crawl on his hands and knees into the darkened room.

The title of *maeuti*, man-grandmother, was given by the Greeks in the time of Hippocrates (400 B.C.) to men called in difficult cases and this spirit prevailed to the scientific period, as indicated by the appellation given Chamberlen, "the man-midwife," who devised the forceps in the middle of the sixteenth century.

We may look to the obstetric practice of a people as indicative of their civilization, culture, and morale. In America the practice of obstetrics is considered not alone as worthy of the physician, but as one of the most important branches of his art, and in this country confinements among native-born women are, as a rule, conducted by physicians. In striking contrast to this in older countries, until fairly recently, even among the higher classes, the treatment of women in labor was largely the province of the midwife.

With the growing importance of anatomical and physiological knowledge, with the supremacy of the male scientific obstetrician, local and national peculiarities gradually fade away and the obstetric art assumes a more important position among the various branches of medical science. Not until recently, however, has obstetrics come to occupy the position it deserves by priority and importance. Side

by side with higher development of the art in our present civilization, the various epochs of the empirical stage through which it has passed still persist. Obstetrics, as it existed before the time of the Pharaohs, and previous to the time of Greek civilization, is faithfully preserved among races and peoples who remain primitive. Side by side with the axis-traction forceps, the perfected cesarean section, aseptic technique, strict teaching, legislative edicts, and most modernly equipped lying-in hospitals, all epochs of empiricism are represented, even to the very earliest intuitive practices, as they must have existed in Egypt or in Greece before the time of Homer.

Among the Mexican Indians and certain negro tribes of Africa, obstetrics persists unadorned by modernization. These simple people with their primitive resources, however, before the taint of present miscegenation of races, were by no means as helpless as might appear at first sight. Labor was more natural, the parturient exposed to fewer dangers, for it is now known that difficulties of childbirth increase proportionately with progress civilly and economically. This is not due so much to degeneracy of humanity, brought about through lives of relative ease and luxury as it is to the danger of infection in crowded localities, and the increasing disproportion between passage and passenger, a change in relationship between the head and pelvis, fostered perhaps by an admixture of races, resulting in hybrids, progenitors of future mutations.

These elements of danger are wanting in the primitive peoples, where intermarriage of nations, or even tribes, is almost unknown. Guided by natural instinct, the expectant mother prepares for her sufferings in seclusion, usually near a stream into which she may plunge immediately after delivery. There her tent is pitched and only those who have had easy, uncomplicated labors resulting in healthy offspring are granted access. Only along the borders of civilization, where natives

are confined legitimately or otherwise, by foreign breeds, is labor looked upon with any degree of apprehension.

Merely as a matter of interest, let us review some of the principal characteristics of intuitive practices, much, though not entirely, like those carried out by our more recently civilized North American Indians, chiefly, the Comanches, Sioux, Kiawas, Flatheads, Creeks and Crows.

First, labor was thought due to a fetal desire to change its environment, its mode of life, as expressed in movements.

Second, the character of the labor was referable to the child, or to its disposition, and a fetus so perverse as to cause difficulty merited death, together with the one who was so evil and cursed as to bear such an one.

Third, in the main, aid was given by varying the posture. The parturient usually assumed a squatting position and thus called into use accessary muscles ordinarily concerned with defecation.

Fourth, the uterus was secondarily stimulated by pressure with the hands, kneading and shampooing, or by compression of the abdomen with the end of a pole or, in some instances, by the application of a belt.

Fifth, a slowly dilating os was stimulated, never dilated manually.

Sixth, as a rule, the funis was not severed until the secundines were extruded. Blunt instruments, a finger nail, or the teeth served the purpose of scissors and the cord was cut usually within a few inches of the umbilicus and then dried as quickly as possible, sometimes by rolling it between the fingers before an open fire for twenty-four hours. The placenta was delivered by various expectant methods, one of which was tying the cord to the great toe, where, upon involuntary extension, mild and limited traction was exerted.

Seventh, post-partum uterine contractions were procured by kneading, by a carefully directed spray of water between the teeth or a plunge into the neighboring stream.

Eighth, the puerperium ended either immediately after the plunge or after an interval of rest, the latter extending over a period of not more than seven days. The period of comparative isolation, during which the parturient and her surroundings were "unclean" varied, but it was the usual custom to smoke or burn elements of contact before she assumed her natural, tribal duties. Supporting belts or binders were worn by some for successive days or months, according to the custom.

Do not these facts impress one that our naive sister had some idea, instinctive if you desire, but none the less comprehensive, of hygiene, of assisting nature, and last but not least, of protecting herself against infection? Through how many years or at what price she gained this knowledge is by its obscurity mysterious. We can think only within limits of the finite, in terms of our own enlightenment. For much we must revert to historical records. From these knowledge is amassed, and it is desirable in an effort at learning to pay strict regard to chronological sequence.

Therefore, this important subject may be divided, according to Courier, into seven periods as follows:

1. All that precedes the time of Hippocrates, when observations were recorded and deductions made therefrom.

2. From the time of Hippocrates, the fifth century B.C., to the Arabian physicians of the ninth century.

3. From the Arabians of the ninth century to their disappearance in the twelfth century.

4. The period of relative darkness, from the thirteenth century to the time of Ambroise Paré, 1550.

5. From Paré to the general knowledge of the obsetetrical forceps in the seventeenth century.

6. From the general knowledge of forceps to the use of chloroform during labor in the middle of the nineteenth century.

7. From the use of chloroform to the present time, including the development and use of antiseptics in obstetrics.

FIRST PERIOD

When obstetrics became an art and was practiced as such we have no means of knowing. It is sufficient to note that in that ancient book, the Bible, abnormalities in parturition were observed, and that the function of the midwife was recognized more than 4000 years ago. Thus the birth of twins, Pharez and Zarah, is noted in Genesis, and the first recorded instance of spontaneous version is given.

And it came to pass in the time of her travail that twins were in her womb. One put out his hand and the midwife took and bound upon his hand a scarlet thread saying—this came first. And it came to pass as he drew back his hand that his brother came out, and she said how hast thou broken forth? This breach be upon thee; therefore, his name was called Pharez and after came out his brother that had the scarlet thread upon his hand, and his name was called Zarah.[1]

The Egyptians of 4000 or more years ago, a highly cultured race, lived in cities. The change from a natural or nomadic life meant more or less change in structural anatomy and, consequently, more or less change in the structure of the pelvis, and this was the occasion for the development of the midwife. The Bible declares that the Hebrew women in Egypt had easier labors than the Egyptians and consequently, the midwives had less occasion to render them assistance.

And the King of Egypt called for the midwives and said unto them, Why have ye done this thing and have saved the men-children alive? And the midwives said unto Pharaoh, Because the Hebrew women are not as the Egyptian women, for they are lively and are delivered e'er the midwives come in unto them.[2]

Difficult labor is recorded in the twin-birth of Esau and Jacob, when the latter presented an arm, an indiscretion constituting an early recorded instance of shoulder presentation.

And when her days to be delivered were fulfilled, behold, there were twins in her womb; and the first came out red all over like an hairy garment, and they called his name Esau. And after that came his brother out and his hand took hold on Esau's heel, and his name was called Jacob.[3]

The difficult labor of Rachel is also mentioned, which, though encouraged by surrounding attendants or midwives, she was unable to withstand and succumbed.

And it came to pass when she was in hard labor that the midwife said unto her—Fear not for thou shalt have this son also. And it came to pass as her soul was in departing (for she died) that she called his name Ben-oni, but his father called him Benjamin.[4]

Other interesting facts in the Biblical account are that the parturient was delivered upon a stool or obstetric chair and the women were accustomed to help themselves when in labor, probably by pressing and pulling on some resisting object.

"And he said when ye do the office of a midwife to the Hebrew women and see them upon the stools, if it be a son then ye shall kill him, but if it shall be a daughter then she shall live."[5]

The law of Moses prescribed the purification of women after labor. It demanded a period for her recuperation, and the return of her genitals to the normal or unimpregnated condition.

The Talmud recognized the period of pregnancy as two hundred and seventy to two hundred and seventy-three days and stated that pregnancy could not be determined prior to the fourth month. It anticipated the error of Hippocrates, that an eighth months' fetus was not viable, and declared that the child floated in the amniotic sac folded up like a scroll.

In Egypt in addition to the midwives, mystics and priests, the latter repositories of much of the knowledge of early times,

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[1] Genesis: xxxviii, 27–30.
[2] Exodus: 1, 18–19.

[3] Genesis: xxv, 24–26.
[4] Exodus: 1, 16.
[5] Exodus: 1, 16.

rendered assistance in difficult labors. Their experiences with the dead supposedly permitted of some knowledge of anatomy however vague.

Obstetrics of ancient India leaves little to posterity in the records. They thought the embryo fastened itself to the womb in the first month, was egg-shaped in the second, that the head and extremities began to grow in the third, that the head and trunk took distinct form in the fifth month and that these became more definite in the sixth and seventh months; in the eighth month the child became uneasy, and was born from the ninth to the twelfth month. The head should always come first, the face turned toward the maternal spine in prayer and looking to earth just before birth took place. It is thought also they possessed some knowledge of extraction by podalic version, cesarean section upon the dead, embryotomy and craniotomy upon the likely still-born, and that they advanced so as to recognize various presentations and abnormalities and possibly devised artificial means in their efforts to remedy the latter.

The ancient Japanese practiced friction of the abdomen to facilitate labor, performed external version, and determined the existence of pregnancy by certain signs in connection with the pulse, abdomen and breasts.

When we come to the Greeks we reach the fountain of recorded observation in arts and science. Naturally we like to invoke Hippocrates who lived in the fifth century B.C. and whom we affectionately revere as the Father of Medicine. The midwives of his day attended all wants of the parturient, encouraging labor pains by massage, sternutatories, and emetics, making the patient walk about and even shaking her if labor was too long delayed. If she died undelivered, the recognized practice was the immediate performance of cesarean section, and when the child was born alive they sang holy songs to greet it. Midwives also induced abortions, which were thought legitimate if in accordance with the desire of the impregnated.

It was in this period that private lying-in asylums were established. In punishment for the mistakes of midwives, which certainly were not few, Aristotle forbade midwifery practice in Athens by a law which was not repealed until 285 B.C.

Hippocrates was a teacher, and it was his belief that a seven months' fetus was viable, while one of eight months was not, a fallacious observation handed down almost to our own time. He and his followers advised the manual separation of the placenta when expulsion was delayed, and laid down rules for destructive operations such as embryotomy, craniotomy, perforation, hook extraction and amputation of the limbs.

The Roman custom of calling upon their goddesses, Lucina, Juno and Diana for assistance obscured Latin scientific contribution.

SECOND PERIOD: 500, B.C. TO 800, A.D.

From the fourth century B.C. to the time of Galen, the first century A.D., little was added to the art. Galen, neither an obstetrician nor surgeon, taught that milk appeared in the breasts as the result of pressure upon the visceral blood vessels; and it was he who advocated what later became particularly noteworthy of the period, that destructive obstetrics was eminently man's domain.

Following Galen there appeared obstetricians of merit. In this group were Celsus, Soranus of Ephesus, Moschion and Aëtius. Celsus (25 B.C. to 50 A.D.) recognized head, thigh, foot and transverse presentations in his practice. Soranus of Ephesus (100 A.D.) remains the most distinguished obstetrical writer of antiquity. He taught that inversion of the uterus might follow hasty or faulty delivery of the placenta, and that premature rupture of the membranes delayed and made difficult labor. He was the first to divert from the belief that the one and only normal presentation was vertex. He devised the knee-elbow

position and did both cephalic and podalic versions in the delivery of living children. One of his pupils, Rufus, was the first to describe the Fallopian tubes.

Moschion described the fetal membranes and taught that the menstrual blood nourished the fetus, that the period of lactation was of eighteen months' duration, that the os might be dilated manually, that the membranes might be artificially ruptured, that the placenta might be extracted manually and that the cord should be tied with two ligatures and cut between them.

With the coming of Aëtius (501–575 A.D.) there appeared a new light in the literary gloom which had persisted for two hundred years. He industriously collected and submitted previously inaccessible writings. He discussed puberty, menstruation, the signs of pregnancy, embryology, the cord, and obstacles of labor. His articles considered the narrow pelvis, the obliquity of the pelvis, the hygiene of pregnancy, the use of pessaries for prolapse of the uterus, ankylosis of the pubis, polyps and other obstructive elements to labor, including distention of the rectum and bladder, as well as the rôle played by the fetus. His originality is further expressed in the use of a vaginal speculum and a pre-forceps device, the two-bladed crochet. The period closes with Aëtius supreme, his followers, amongst whom was Paul of Aegina, carrying on as imitators.

THIRD PERIOD

After Paul of Aegina came a period of sterility and darkness until the Arabs picked up the torch in the ninth century. Arabian medicine found its principal disciple in Avicenna of Ispahan, an adherent of the Greeks, who dignified their mistakes by repetition. With his name, appearing between the ninth and twelfth centuries, are those of Albucasis, Misdrach and Almisdrach, all advocates of the destructive forceps.

With the downfall of the Arabs at the end of the twelfth century, came another long period of obstetrical gloom, though illumined before and afterward by an occasional gleam of light. But before this downfall there was founded the school of Salerno, in the eleventh century, followed by those of Bologna and Paris, with the translation of the Arabic writers into Latin of the Middle Ages.

FOURTH PERIOD

The thirteenth and fourteenth centuries are mostly a blank, except for the appearance of an unimportant work on "Reproduction and Birth" by Albertus Magnus, a Dominican priest of the thirteenth century (1193–1282).

In the fifteenth century the Renaissance had already appeared, printing had been discovered, the universities of Prague, Rostock, Leipzig and Griefswald had been founded, and Italian gynecologists were at work.

In 1513 Rösslin published "A Garden of Roses for Pregnant Women and Midwives," a compilation of what had been written since the time of Hippocrates, and in 1554 Rueff, of Zurich, published a book for midwives, following closely the principles found in Rösslin to which he added descriptions of manual dilatations, extractions of placenta, alterations of position in delay, and a long, smooth, duckbill forceps for extraction of the head, for which latter he is therefore accredited by Crantz, Stein and others, as inventor of the forceps. Rueff, however, made only a forward step in advance of Aëtius, for his forceps were truly destructive.

The sixteenth century opened the first clinic for the instruction of midwives at Padua.

In England in 1518, Lanfranc, the court physician to Henry VIII, obtained a "patent" for the Royal College of Physicians from which time obstetrics assumed importance in that country. The first English work of merit was published by Raynolds in 1565, "The Byrthe of Mankind." This effort, though translated into Dutch, French, Spanish, Latin and other languages, bore two mistakes of note; that

vertex presentation was the only natural position and that the face and foreparts of the child faced the foreparts of the parent.

FIFTH PERIOD

There was every reason why all departments of medicine should now make great progress. Letters had revived, the art of printing diffused with great rapidity, Vesalius, Columbus and their followers had developed the anatomy and physiology of the pelvis as never done before, and the mistakes of 2000 years, dating from Galen and Hippocrates were rectified. To this period belong Fallopius and Eustachius.

The real genius in obstetrics next appeared in France in the person of Ambrose Paré, whom Smellie honored in the expression, "The famous restorer and improver of midwifery." Paré was in association with the school of Paris, at this period the foremost in the world, and surgeons of his following thought it not beneath their dignity to emulate Paré even in the realm of obstetrics. For the first time men began to encroach upon the domain and prerogative of midwives, to dispel the inherent modesties of woman. It was Paré who instituted cesarean section on the living, imitating Jacob Nufer, a sow gelder, who thus successfully delivered his wife. Paré recognized five positions assumed by the fetus, but admittedly declared his ignorance as to which was normal. He was indeed a conservative obstetrician, and an adept at podalic version.

To this period belongs the discovery of our modern obstetric forceps by Peter Chamberlen who practiced in London, under license of the Barber Surgeons Company, 1598 to 1630. He was accoucheur to the Queens of James I and Charles I. The three generations which followed him, kept the family secret which was finally sold to Roonhysen of Amsterdam in the latter part of the seventeenth century.

SIXTH PERIOD

In the seventeenth century man-midwives, as obstetricians were called, had become fashionable in France and among those Maurceau was preeminent. He corrected the idea prevalent that amniotic fluid consisted of maternal blood and milk; he described the phenomenon of normal labor, called attention to placenta previa, described the necessary steps in the performance of version, denied that the pelvic bones separated in labor, discussed difficulties proceeding from the umbilical cord, epidemic puerperal fever, and gravity as a factor in vertex presentation, declaring that fetal movements were not, while muscles were responsible for birth, and was the first to call attention to tubal pregnancy.

In England, Willis defined puerperal fever and Needham wrote on fetal nourishment by way of the placenta.

Van Deventer, of Holland, dealt chiefly with deformities of the pelvis and spine and their effects on labor.

Palfyn presented a parallel, bi-blade forceps to the Academy of Science in Paris (1717) and was criticized severely by De la Motte, who wrote rules for version.

In 1747 Smellie or Levret added the pelvic curve to Chamberlen's invention.

Puzos, a French enthusiast, advocated external abdominal pressure to control post-partum hemorrhage, the early rupture of membranes in placenta previa, the protection of the perineum during delivery and friction of the os uteri to induce labor pains. Baudelocque contributed treatises on pelvic measurements, symphysiotomy and the induction of labor.

Germany's influence is comparatively nil until the next century, though Siebald performed a symphysiotomy in 1778. Among others whose names have come down to us as significantly important in their time may be mentioned Stahl, Roederer, Stark, Stein, Zeller and Heiser of Helmstadt. Heiser was the first to deliver lectures on obstetric science.

Great Britain offers many names in connection with obstetrics of the eighteenth century. Manningham, like his contemporaries Smellie and Hunter, employed manikins to demonstrate procedures of examination and delivery. He vehemently

protested against cesarean section, scoring it as a hopeless risk. With Van Deventer he advocated the depression or fracture of the coccyx as an aid in difficult labor.

Fielding Ould, a Dublin physician of 1742, was the first to describe the mechanism of labor further elaborated upon by Smellie and later revised with an endowment of perfection by Naegele. At this time version was the recognized practice of selection, while delivery by forceps was rather neglected. However, Smellie devised the precursor to low forceps, an instrument of application in our own day. William Hunter, his pupil, and for many years a distinguished practitioner in London, built an anatomical theater in which he demonstrated obstetrics through the use of manikins, and collected a series of unexcelled plates made during thirty years' dissection upon pregnant uteri. He discovered the decidua reflexa and, unlike Smellie, refused to use forceps of whatever design, and proudly exhibited his own implement rusty from disuse.

Charles White was at this period a prolific writer who received the distinction of being the pioneer in antiseptic midwifery; yet a century passed, with its toll of lives lost to puerperal fever, before the suggestions of White bore fruit. Thomas Denman's article on the transmission of infections by doctors and midwives was completely ignored.

John Aiken, the advocate of an exsection of part of the bony pelvis in preference to cesarean section, and R. W. Johnson, who devised a forceps with pelvic and perineal curves, honored the end of this period in England.

In the United States, it is interesting to note that the closing years of the eighteenth century, which witnessed our entrance into the family of nations, also marked the beginning of obstetric teaching by the younger Shippen in Philadelphia (1765).

The nineteenth century found obstetrics well established in all parts of the civilized world and its principles well understood and comprehensively set forth in textbooks

of the different languages. Henceforth, there remained, with the exception of anesthesia and the development of the antiseptic theory, only the improvement or elaboration of ideas laboriously wrought down through the ages.

It was a century preeminently devoted to teaching as shown by the following outline:

In learning Germany ranked first with her elegantly regulated universities, guided by geniuses of skill and erudition. Vienna, where instruction is truly German, remains, with her Allegemeines Krankenhaus, an attractive center for students from all parts of the world. It was there that Semmelweiss preached the "Doctrine of Cleanliness to deaf ears," and lost his mind in disappointment and chagrin when his efforts failed. The following generation realizing that his hands, dipped in chloride of lime, were by far cleaner than the hands of those who scoffed at his theory, erected a monument to his memory.

Germany at this time also had pride in such men as Boër, Schmitt, Gustav, Carl Braun and Spaeth. Prague University had Klein, Wächter, and Jungmann; Munich, Hecker and Winkel; Breslau had Spiegelberg; Würtsburg had Doutrepont, Kiwisch, and Scanzoni; Berlin, Von Seebald, Busch, Edauard Martin, Schraeder and Gusserow; Leipzig, Sanger, who perfected cesarean section.

Original works of the period were indeed not wanting. Deformities of the pelvis were carefully studied and placed in the literature by Naegle, Rokitansky, Leitzman, Stein, Micheals and Klein. Other German scientists, assured places in posterity through their contributions, were Waldemeyer, Walcher, Credé, Wenzel, Stark, Hohl, Carus, Wigang, Ritgen, Kilian, Fehling, Zweifel, Ahlfeld and Leopold.

In France, Paris was the center of learning. At the University were Velpeau, Baudelocque and Stoltz, the last-named being the first to associate his name with the study of premature labor.

Two books, the seeds from which texts subsequently sprang, compilations from

the study of 40,000 cases, were written by Mesdames La Chappelle and Boivin, French midwives of commanding intellect. To the latter is attributed the first description of hydatidiform mole. With the appearance of Lord Lister's antiseptic theory, Tarnier closed French obstetrical history for the period with his contribution of the axis-traction forceps.

In the nineteenth century Great Britain gave birth to many obstetricians and by the luster of her schools at Dublin, Edinburgh and London, acquired others. English texts bear the names of Churchill, Barnes, Leishman, Playfair, Milne, Galabin, Duncan and Ramsbotham. Barnes contributed the dilating bag, and Braxton Hicks the combined internal and external version.

In England it was the period of physiological acknowledgment, where nature was granted her portion in contradistinction to the previous form of "meddlesome midwifery."

SEVENTH PERIOD

The most brilliant and useful obstetric discovery of this century was that of chloroform anesthesia for labor by James Simpson of Edinburgh. Although the anesthetic powers of sulphuric ether had already been announced by the Americans, Morton, Jackson, Wells and Riggs, Simpson was a pioneer in eliminating painful labor. But even more important than the discovery of a means to eliminate or at least mitigate pain, was Lord Lister's theory of antisepsis, in which the bud nurtured by White and Semmelweiss burst into bloom.

Surgical obstetrics took a firm footing during this century in Italy where Morisani, Galbiati, and Gigli revived symphysiotomy and Bossi introduced the mechanical dilator.

American obstetrics, although a new element among scientific forces, was able to exert great influence through the teachings of Dewees, Hodge, Meigs, Goodell and Parvin in Philadelphia. Their text-books, with that of Lusk, have influenced American obstetric practice even to this day. In New York, Boston, Baltimore and Chicago schools have gained prominence through their excellent work.

Early in the century, 1808, John Stearns of New York introduced ergot to the profession.

In 1843 Dr. Oliver Wendell Holmes wrote a noteworthy essay on "The Contagiousness of Puerperal Fever," and thus we are led to the threshold of the present, to our contemporaries, who are putting forth their best efforts to solve remaining problems.

The work of contemporaneous American obstetricians is not yet a matter of history; but in teaching, in the development of textbooks and treatises, and in the practical application of the science and art of obstetrical practice, the American obstetricians of today are in the forefront and doing work as good as is done anywhere in the world.

This paper could have no greater purpose than to commend to teachers and students the remaining problems of obstetrics, with special emphasis on practical instruction in the lying-in chamber, on perfection in the management of normal labor, and on general obstetrical research and the introduction of the antiseptic methods of the hospital into private practice.

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BOOK REVIEWS

SURGICAL DYSPEPSIAS. By A. J. Walton, M.S., M.B., B.SC. Ed. 2, 720 pp., 286 illus., N. Y., Longmans, Green & Co., 1930.

Too many textbooks are written by men who seem to be handicapped either by a lack of clinical experience or else by a reluctance to depend on it for their inspiration. Too often they spend most of their time copying from older books, the writers of which copied from still older sources. As a result, the literature on every subject is cluttered up with statements which, although hoary with antiquity, are wrong and misleading. It is, therefore, a joy when one finds in a new book a thorough discussion of a subject by some man who has lived and worked and observed closely, and who has had the courage and the ability to describe well what he saw.

The reviewer regrets that he hasn't the time to read Walton's book from cover to cover. The distinguished London surgeon naturally looks at disease of the digestive tract from the point of view of the surgeon, but this makes his book all the better for the gastroenterologist, who ought more often to learn when to render unto the surgeon what is his. Most of the space is devoted to a discussion of gastric and duodenal ulcer, carcinoma and sarcoma of the stomach, surgical diseases of the liver, biliary tract and pancreas, and the technique of operations on the stomach and gall bladder. The last two chapters on the surgical treatment of visceroptosis, which in this edition have been greatly shortened, might well have been omitted.

In these days, when many gastroenterologists are still hooting at the idea that there is danger in treating large gastric "ulcers" medically, it is refreshing to find an intelligent discussion of the problems involved. It is comforting also to find on page twenty-one the statement that "if the patient has been free from all abdominal symptoms until a few weeks or months before advice was sought, it is unlikely that the disease is one of chronic gastric or duodenal ulcer, gall stones, or visceroptosis. If over middle age, and the history has been short, it is probable that the condition is one of carcinoma of the stomach."

An American physician or surgeon writing such a book would probably have put in more detail about the preoperative and postoperative care of patients, about the avoidance of dehydration, and about the use of modern laboratory methods, but the reviewer does not feel like caviling about minor defects in an otherwise thoughtful, interesting, and useful book. Having himself lived through long weary months, during which every spare moment was devoted to writing and to the correction of manuscript and proof, he has great admiration for and gratitude to the busy surgeon who could find time to write so much and so well.

CLINICAL ALLERGY. By Francis M. Rackemann, M.D. 631 pp., 30 illus., N. Y., The Macmillan Co., 1931.

Here is a practical and at the same time scientific work on "Clinical Allergy." The subject is discussed from every angle and the bibliographic references at the end of each chapter render further data easily available. "Mechanism and Treatment of Asthma and Hay Fever" are also taken up in the most practical manner. Appendix A, with an "Alphabetical List of Those Foreign Substances (Allergens), Except Pollens, Proved to be Causes of Allergic Manifestations as Recorded in the Literature and in Practice," is invaluable and, we believe, unique in its completeness. Appendix B, with a discussion of "Asthma Nostrums" should enable the physician to annihilate any patient's faith in any of the substances listed. This is a type of monograph that is badly needed in medical literature and the author is to be congratulated on the production of a work that is a credit not only to himself, but to the entire profession.

HOW IT HAPPENED. By Adalbert G. Bettman, M.D., F.A.C.S. 110 pp. Phila., F. A. Davis Co., 1931.

Edgar Lee Masters for writing his "Spoon River Anthology" has much to account for. "How It Happened" is one of the things he will have to take the blame or credit for. We suppose it would be called blank verse, though we can see no verse to it at all.

Rather tritely and tartly, the stories are told of many of the problems that the doctor must face. The boy, who "painted the town red" just once after the army examination and then landed in the venereal squad, is here

with the girl, who had to suffer for appearances being against her. The mother, who was too busy to nurse her baby, and the wife, who put off having children for too long, both tell their tales of woe.

The stories are there; they are true; they are known to every physician. If the book were read and its lessons taken to heart by those for whom it is intended, it would be worth while. But, will those who need it, read it? If they read it, will they heed it? That is the question!

The author is a crusader with the courage of his convictions and is to be congratulated on his willingness to express them in a rather unconventional form.

DIET AND CARE OF THE SURGICAL CASE. By Reynold H. Boyd, M.B., CH.B. (N.Z.), F.R.C.S. (Edin.). 110 pp. London, H. K. Lewis & Co., Ltd., 1930.

A short and practical book on a subject of utmost importance to every surgeon. It presents a definite point of view concisely yet completely. A similar work based on American practice would be very desirable in this country.

MEDICAL JURISPRUDENCE. By Elmer D. Brothers, B.S., LL.B. Ed. 3, 309 pp., St. Louis, The C. V. Mosby Co., 1930.

This is the third edition of a concise and practical book on "Medical Jurisprudence." Where a larger book is not available, it will be found a great convenience to have this volume on hand for casual reference.

ORAL DISEASES. By James L. Zemsky, D.D.S. 402 pp., 414 illus., Brooklyn, Physicians and Surgeons Book Co., 1930.

A hastily put together and much padded monograph that will be of greater interest to dentists than to surgeons.

DIE ROENTGEN LITERATUR, X Teil, 1929, Autoren—Und Sachregister 1929 Patentliteratur 1929, by Dr. Herman Gocht,

University of Berlin. Stuttgart, Ferdinand Enke, 1930.

Here is another volume of Dr. Gocht's periodical listing of the roentgenological literature. This tenth volume includes much of the 1929 literature on the x-rays in diagnosis and therapy, but one notes with regret the failure to include some important American contributions. It would increase American interest in these valuable annual contributions if more care were exercised in making the list complete. This series of literature references constitutes a nearly complete bibliography of the entire literature on roentgenology. It should be found in every medical library.

LES FONCTIONS HEPATO-BILIAIRES. By M. Chirary et F. Thiebault, Paris, Masson et Cie, 1930.

This is a brief summary of practically all of the tests that have ever been proposed for the estimation of liver function. The book doubtless will have some interest for specialists in this field but, unfortunately, the writers, if they have had any clinical experience with the various tests, fail to mention it. Their lack of clinical experience is indicated by their failure to note that at least in this country the test of Abel and Rowntree, modified by Rosenthal, is the one commonly used. Strange to say, there seems to be no mention of Rowntree in the whole book.

TECHNIQUES HISTOLOGIQUES DE NEUROPATHOLOGIE. By Ivan Bertrand. Paris, Masson et Cie, 3-6 pp., 1927.

This is the most complete treatise on the subject yet available, covering as it does all the technical methods which are of use to the neuropathologist. It includes everything that is necessary, even down to details of making autopsies. Every laboratory has its own modifications of the various methods; modifications which it would obviously be impossible to include, but otherwise the volume is complete. Every neuropathologist will want to have a copy.

PRINCIPLES OF PREOPERATIVE & POSTOPERATIVE TREATMENT

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PRINCIPLES OF PREOPERATIVE
& POSTOPERATIVE TREATMENT

CHAPTER V

BLOOD TRANSFUSION

1. DEFINITION OF TERMS

Blood transfusion may be defined as the process by which either unchanged whole blood or blood to which an anticoagulant has been added is transferred from the blood vessels of one person to those of another for therapeutic purposes. The person receiving the blood, i.e., the patient, is technically known as the *recipient*, and the person giving it is designated as the *donor*. When unchanged blood is allowed to flow directly out of the vessels of the donor into those of the recipient, or in cases in which the intermediate channel of transfer is merely a tube without other accessories, the process is called *direct transfusion;* when the blood is first withdrawn into some form of vessel or reservoir and then injected by means of pressure other than that generated within the vessels of the donor the process is called *indirect transfusion.* Accordingly, direct transfusion always signifies the transferene of blood virtually exactly as it circulates in the vessels of the donor, i.e., *unmodified* or *whole blood*, whereas in indirect transfusion either whole blood or blood to which an anticoagulant has been added may be used, depending on the particular indirect process employed.

Though originally transfusion was devised as a life-saving method in the presence of severe hemorrhage, recent refinements of technique and, more especially, a better understanding of the physics, chemistry, and serology involved in the process have so simplified the procedure and obviated harmful incidental reactions that the indications for the performance of transfusion are at present somewhat more liberally construed.

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II. HISTORICAL CONSIDERATIONS

Although various obscure references are made to blood transfusion in the literature of the Middle Ages, blood transfusion as it is known today was made possible only as a result of the theory of the circulation of the blood, first propounded by Harvey[1] in his lectures in 1616, and later committed to writing in 1638. Such references to transfusion as occur in the literature prior to this time probably must be understood as referring to the administration of blood *per os*.

So far as is known, the first transfusion in animals was made in England by Richard Lower in 1665. He successfully connected the artery of one dog with the vein of another by means of a goose quill. Two years later the experiment was repeated on man by Jean Baptiste Denys[2] (Kohner and Ravdin[3] say Sir Christopher Wren and Archibald); in this case the blood of a lamb was given to several men with the production of urine described as "black as soot," the latter, of course, being due to hemoglobinuria. In 1835, Virchow (Kohner and Ravdin say Bishop) introduced the use of defibrinated blood, and the use of the latter method found some advocates subsequently.

Erasmus Darwin, the father of the naturalist, in 1796, suggested a quaint piece of apparatus for indirect transfusion; it consisted of two goose quills united by a length of chicken gut. Blood was to be allowed to flow from the donor through one of the quills until the chicken gut was distended, and then by pressure on the gut the blood was to be displaced into the veins of the recipient. This apparatus, so far as recorded, was never assembled and tried.

Blood transfusion remained in a retarded stage of development, used only as a last resort to save life, and then attended by the gravest of reactions and many fatalities, until the beginning of the present century. In 1898, Crile began to renew interest in blood transfusion in the United States by his researches on the technique of direct transfusion, and this renewal of interest came at an opportune time, because the

beginnings of a new understanding of the principles of transfusion were soon to follow.

III. Blood Grouping

In 1900 Landsteiner[4] and Shattoek[5] laid the foundation for the modern practice of transfusion in their observation that agglutination of red cells occurs when the scrum of certain individuals is mixed with the red cells of certain others. They discovered, further, that such agglutination of red cells is sometimes the forerunner of hemolysis and that although hemolysis does not always ensue upon agglutination, hemolysis without previous agglutination does not occur.* The hemolysing action of the scrum of the recipient on the cells of the donor, and the reverse, was thus discovered to be the underlying reason for the previously unexplained hemoglobinuria and attendant unpleasant or fatal reactions observed in transfusion. As a result of his studies, Landsteiner divided human blood into three classes with respect to its agglutinating powers, and to this classification Deeastello and Sturli,[6] in 1902, were able to add a fourth. In 1907 Jansky[7] reviewed the preceding work, and reported the classification which has been subsequently accepted. It must be added here, however, that no small amount of confusion has arisen among transfusion workers from the fact that Moss,[8] working independently, reported in 1910 essentially the same facts as Jansky had done three years earlier, although Moss numbered the groups in a different sequence.

Unfortunately, the report of Jansky was published in the Bohemian language and appears to have aroused little or no general interest due to the relative inaccessibility of his contribution. Moss's classification, however, was published in English and was soon very favorably accepted, especially in English speaking countries. Moss heard of the work of his

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* This is not literally true, as Kohner has shown that agglutinins are separable from hemolysins by heat, but the statement may be accepted as accurate for practical purposes.

predecessor in the field, Jansky, only after his own paper had gone to press, and he stated in a note at the end of his contribution that had he known sooner he would have been glad to have given Jansky credit for priority.

Notwithstanding the fact that Jansky's classification clearly deserves priority and that to this opinion the American Association of Immunologists, the American Medical Association, the Society of American Bacteriologists, and the Association of Pathologists and Bacteriologists, the Medical Department of the United States Navy, and others officially gave their sanction in 1921, various groups and individuals in the United States and elsewhere have persisted in the use of the Moss classification, whereas others have just as persistently adopted or clung to the Jansky nomenclature. This lack of uniformity in the classification of blood groups is not only very disconcerting to the physician, but is somewhat of a menace to the patient, because it paves the way for misunderstandings which may occasionally result seriously or even disastrously to the recipient of a transfusion. The so-called groups II and III correspond in both nomenclatures, but groups I and IV are reversed, group I Jansky corresponding with group IV Moss and *vice versa*.

In an attempt to pave the way for a universal nomenclature which would clarify a situation in terminology which was apparently not becoming much better with the passage of time, the American Association of Immunologists sponsored in 1927 a new classification suggested by the original discoverer of blood groups, Landsteiner, and which is variously called the "International Classification," the "Modified Landsteiner Classification," and the "National Research Council Classification"; this classification has met with the approval of the medical authorities of many foreign countries and has been adopted for use in the United States Army and Navy. It uses letters instead of numbers, o, A, B, and AB. The hypothetical agglutinogens of Von Dungern and Hirschfeld[9] which are supposed to be distributed among the red cells of the various

groups and to which their agglutinating properties are supposed to be due are the basis of the new classification; these were designated by their hypothecators as A and B. Group O, accordingly, has the significance zero and indicates that neither agglutinogen A nor B is present in the group thus designated. Group A contains agglutinogen A, and group B agglutinogen B, whereas group AB contains both A and B. A tabular com-parison of the various nomenclatures follows:

	International	Jansky	Moss
Group....	O	I	IV
Group....	A	II	II
Group....	B	III	III
Group....	AB	IV	I

Whether the latest classification will permanently solve the problem of the terminology only time will tell, but for the present it seems necessary to be familiar with all three nomenclatures. For the purposes of the present discussion the Jansky classification is used because of its claims to priority and because of the sanction it received so generously in 1921.

Jansky's Classification

Group I blood:

> *The serum* agglutinates the erythrocytes of all the remaining three groups (but, naturally, not its own cells).
> *The cells* are not agglutinated by the serum of any of the other three groups (and, naturally, not by its own group serum).

Group II blood:

> *The serum* agglutinates the cells of groups III and IV but not group I (and, of course, not its own group cells).
> *The cells* are agglutinated by the sera of groups I and III but not by that of group IV (or its own serum).

Group III blood:

> *The serum* agglutinates the cells of groups II and IV but not those of group I (or its own cells).

The cells are agglutinated by the serum of groups I and II but not by that of group IV (or its own serum).

Group IV blood:

The serum agglutinates the cells of no group (including its own).

The cells are agglutinated by the serum of all the other groups (though not, of course, by its own).

Expressed in another way group I may be considered as a group of "universal donors," since the cells of this group are not agglutinated by the serum of any other group, whereas the serum does not agglutinate the cells of any other group. Similarly group IV may be considered as a group of "universal recipients," for, although its serum does not agglutinate the cells of any other group, its own cells are invariably agglutinated by the sera of all the other groups. Groups II and III are intermediate between these two extremes and may be considered as both donors and recipients.

Represented graphically, the classification may be expressed as follows:

Cells of Group	Serum of Group			
	I	II	III	IV
I	−	−	−	−
II	+	−	+	−
III	+	+	−	−
IV	+	+	+	−

Serum of Group	Cells of Group			
	I	II	III	IV
I	−	+	+	÷
II	−	−	+	÷
III	−	+	−	÷
IV	−	−	−	−

This classification of reactions was accepted without reserve as given here until within the last few years; it is now pretty well established, however, that certain exceptions occasionally occur to this rule. These exceptions concern group I, or the group of universal donors, so far as is now known (though

similar discrepancies may subsequently be discovered in connection with other groups) in that the cells of the blood of certain members of group I are occasionally agglutinated by the serum of certain other members of group I.

The discussion of the mechanism underlying blood grouping has occasioned a considerable amount of speculation which does not properly fall within the scope of a work of this kind and will not be discussed here, but the approximate percentage distribution of individuals in the various groups is of practical interest and may be mentioned in passing.

The following table is representative of the results reported:

(Jansky Grouping)	I Per Cent	II Per Cent	III Per Cent	IV Per Cent	
Moss....................	43.	40.	7.	10.	(1600 cases)
Culpepper and Ableson.	44.48	36.06	14.28	5.18	(5000 cases)
Karsner..................	42.84	41.38	10.36	5.42	(5000 cases)

It may be further observed that the blood groups do not become established until the first year of life, and that they follow the Mendelian law of heredity, so that, whereas a child is more likely to be of the same group as his parents than of some other group, he is not by any means necessarily so.

Any mechanism of agglutination to be entirely satisfactory must be capable of explaining a number of strange facts which seem to have been established recently, such as:

(a) Absence of a sufficient amount of green vegetables in the diet apparently diminishes the agglutinating power of group III serum for the cells of other groups and also interferes with the agglutination of the cells of this group by group II serum.

(b) In certain cases of pernicious anemia and in acquired hemolytic jaundice a patient's serum may agglutinate his own cells, and in paroxysmal hemoglobinuria such a condition develops spontaneously at intervals, as after exposure to cold.

(c) Hemolysis of a person's cells may be brought about by his own serum outside the body when that serum has been chilled and is later allowed to come into contact with his red cells.

A. The Value of Grouping: From a practical point of view blood grouping is of importance as a means of deter-

mining the probable suitability of such persons as may wish
to provide blood for transfusion and as concerns the recipient,
the probable group sources to which a patient may look for a
supply of blood in case of an emergency. Blood grouping alone
is no longer regarded as a safe and proper criterion of blood
compatibility in any actual transfusion, i.e., it is not safe to
assume that because, for example, a given person belongs to
group I that he can safely give blood to a person in group IV, or
III or II, since it is feasible to perform a direct compatibility
test previous to transfusion and thus avoid the possibility of
atypical reactions such as have been mentioned before.*
However, in emergencies it is not absolutely necessary that
the serum of the donor does not agglutinate the cells of the
recipient, since the donor's serum becomes so much diluted in
the vascular system of the recipient as usually to render the
aforementioned donor's serum innocuous for practical purposes,
whereas the reverse of this is the crux of the entire situation:
*the serum of the recipient must never agglutinate the cells of the
donor.* This latter statement could be disregarded only in cases
of dire necessity, the possible alleviating circumstance in any
given case being that agglutination might occur without actual
hemolysis, though agglutination would in any case be highly
undesirable. It has been estimated that 30 per cent of random
transfusions will give rise to hemolysis of the donors' erythro-
cytes and that in 5 per cent of these cases will occasion serious
symptoms.or even fatalities.

In the event that incompatible bloods are mixed through
transfusion cyanosis, rigors, pains across the back, hyperpnea,
pyrexia, and rapid pulse are the symptoms that may be noted,
in addition to a hemoglobinuria in those cases in which the

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* Not all authorities are agreed that direct matching of blood is essential in cases
other than the blood dyscrasias, the case with jaundice, and the patient so devitalized
from loss of blood that even a moderate reaction might be hazardous; but, on the one
hand, such cases represent a relatively large proportion of all cases, and on the other since
direct matching is so simple a matter compared with the undertaking of transfusion as
a whole, economy either of time or expense in the matter of the simple operation of
direct matching would seem to be ill-advised.

liver of the recipient is unable to convert released hemoglobin into bile pigments with sufficient rapidity.

The performance of a blood typing test is by no means difficult and involves so little time and equipment that with a little practice it can be performed readily by almost anyone.

B. TECHNIQUE OF BLOOD GROUPING USING GLASS SLIDES: 1. *Technique using "type sera"*: The apparatus necessary for the performance of blood grouping consists of the following:

(a) Known sera belonging to groups II and III respectively. (These are supplied by commercial biological laboratories sterile and in small glass bottles or ampules; their sterility being preserved, the sera may retain their agglutinating activity for months.)

(b) A microscopc slide and two coverslips.

(c) A small test-tube containing 5 c.c. of normal saline solution.

(d) A suitable needle or blood lancet.

The test proceeds with:

(a) Puncture of the finger or lobe of the ear to obtain one good-sized drop or two smaller drops of blood;

(b) Thorough shaking of the blood thus obtained with the 5 c.c. of saline solution in the test-tube, so as to form a uniform emulsion, centrifugalization, removal of supernatant fluid with a pipette, and addition of 5 c.c. of fresh saline (to make approximately a 10 per cent emulsion of washed red cells);

(c) Transfer of a platinum loopful of each of the known sera to opposite ends of the microscope slide;

(d) Addition to each of the latter of a loopful of the red-cell emulsion;

(e) Overlaying of the specimens with the two coverslips, being careful not to squeeze out the underlying drops;

(f) Examination with the naked eye or, if desired, under the low power of the microscope at the end of one, five, and ten minutes.

(From a practical point of view it has been found advantageous to place the drop of type II serum always at one end of the

FIG. 10. Various reactions that may occur in blood grouping when using the standard II and III type sera and a macroscopic method employing glass slides and coverslips. The technique of preparation is described in the text. Roman numerals indicate position of the two type sera; these need not be actually labelled if the relative positions be habitually maintained with respect to the ends of the slides as described in the text. Reading from above down, reactions are those observed with type I, type II, type III, and type IV bloods respectively (Jansky grouping). The preparations were not made with any particular care since it was desired to represent a typical series of reactions such as anyone might obtain or be called upon to interpret. As will be noted, the smears in both the upper specimens, in the specimen on the right in the second slide, and the specimen on the left in the third slide are all homogeneous except for presence of bubbles and other variations due to imperfect technique; on the other hand, all of the other specimens show a typical and unmistakable "brick-dust" appearance which represents agglutination of red cells.

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slide and the drop of type III serum rather nearer the middle; in this way mistakes caused by accidental or unnoticed shifting of the slide, end for end, do not occur, since the drop nearest the end of the slide must always be type II.)

2. *Technique Using Blood from Persons Known to Belong to Type* II *or* III: Although the previously described procedure is the kind of reaction ordinarily performed in blood typing and requires the use of stock sera, it may be interesting to observe and on occasion very important to remember that perfectly satisfactory typing may be performed in the absence of such sera provided fresh blood can be obtained from some person known to belong to either type II or III. Frequently the person doing the matching can use his own blood for the purpose.

The technique using such blood proceeds as follows:

Blood is obtained by puncturing either the lobe of the ear or the finger, or when necessary by venipuncture, from both the person to be tested and the person with the known type blood. A large drop or two from first one and then the other is allowed to fall into about 5 c.c. of normal saline solution in each of two test tubes (the exact amount is of on particular moment), and as much additional blood as can be conveniently obtained is subsequently collected in a pair of dry tubes. There are now four tubes, two of which contain blood in saline and the other two blood alone; one of each pair represents blood taken from the person to be tested whereas the other represents blood known to belong to type II or III. The tubes containing the blood in saline are placed aside to settle or, better still, are centrifuged; the blood in the dry tubes is allowed to coagulate. The clear supernatant fluid is withdrawn from the tubes containing the saline solution, thus leaving only washed red cells in the bottom of each tube; about ten volumes of fresh saline solution are now added to each, and the tubes are shaken.

The actual agglutination reaction is performed by mixing on a clean glass slide one drop of clear serum taken by pipette from one of the test tubes in which coagulation has occurred

with one drop of 10 per cent emulsion of red cells also removed by pipette; known serum is, of course, mixed with unknown red cells in one preparation whereas known red cells are mixed with unknown serum in a second preparation. Both preparations are kept in a warm place and are observed for the development of a brick dust appearance which signifies the occurrence of agglutination. Agglutination will usually occur within one minute, but it is not safe to read a negative reaction in less than five minutes. The slide is examined with the naked eye, preferably while holding it about 2 in. above the surface of a sheet of white paper laid on a table. In cases of doubt the inversion of a coverslip over the open preparation will emphasize the size of any conglomerated clumps of cells which may be present, as such a maneuver flattens out the clumps which tend otherwise to be spherical in shape. In order to get the full effect of this procedure, however, the coverslip should not be applied until agglutination has had a chance to occur.

As soon as the two reactions have been read the blood group of the unknown becomes apparent through a process of logical deduction, e.g.,

Example I

The known blood belongs to group III. By cross-matching it is found (1) that the serum of the known specimen agglutinates the cells of the unknown specimen (2) but that the cells of the known specimen are not agglutinated by the serum of the unknown specimen.

Process of deduction (using Jansky's classification):

(a) The serum of group III is known to agglutinate the cells of groups II and IV only, so that the unknown blood must belong to one of these.

(b) The cells of group III are known to be agglutinated only by groups I and II.

(c) The only group which is common to both A and B, i.e., that fulfills the conditions actually found, is group II; consequently the unknown must belong to group II.

Example II

The known blood belongs to group II. By cross-matching it is found (1) that the serum of the known specimen does not agglutinate the cells

of the unknown; (2) neither are the cells of the known specimen agglutinated by the serum of the unknown.

Process of deduction (using Jansky's classification):

(a) The serum of group II is known to agglutinate the cells of groups III and IV only, so that the unknown must belong to either group I and group III.

(b) The cells of group II are agglutinated only by group I and group III.

(c) The only group which is common to both A and B, i.e., that fulfils the condition actually found, is group I; consequently the unknown belongs to group I.

From reasoning the various possible combinations through in this manner Table I can be constructed and will serve for rapid reference. In the interest of completeness the table is made to include type I and type IV sera, though neither of these, as will be seen, can be used for the purposes under discussion.

TABLE I

	Serum of Known and Cells of Unknown	Cells of Known and Serum of Unknown	
Group I	$-$(I)	$-$(I, II, III, IV)	I
		Does not occur	
	$+$(II, III, IV)	$-$(I, II, III, IV)	No conclusion
		Does not occur	(II, III, or IV)
Group II	$-$(I, II)	$-$(II, IV)	II
		$+$(I, & III)	I
	$+$(III, IV)	$-$(II, III)	IV
		$+$(I, III)	III
Group III	$-$(I, & III)	$-$(III & IV)	III
		$+$(I & II)	I
	$+$(II & IV)	$-$(III & IV)	IV
		$+$(I & II)	II
Group IV	$-$(I, II, III, IV)	$-$(IV)	IV
	$+$ Does not occur	$+$(I, II, III)	

IV. DIRECT MATCHING

A. TECHNIQUE USING GLASS SLIDES: The process of direct matching of the blood of the donor with that of the recipient
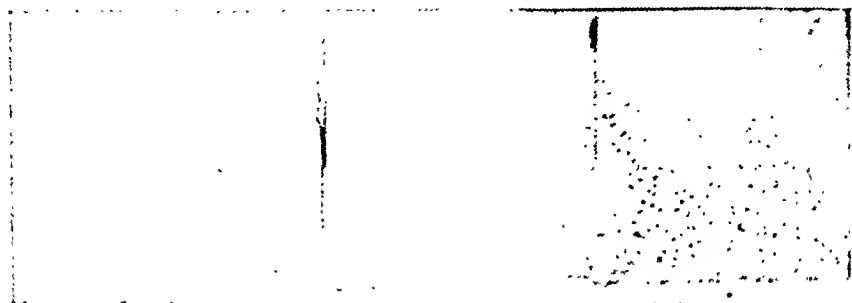
FIG. 11. Macroscopic appearance of a microscope slide on which cross matching has been performed. Under the central coverslip the emulsion is homogeneous, under the coverslip at the end is shown the typical brick-dust appearance of agglutination. The donor and recipient are incompatible.

is no more difficult nor does it entail the use of more equipment, or the expenditure of a greater amount of time, than the process of simple typing. It is performed after the donor and recipient have been brought together, usually just prior to the performance of the actual transfusion and may or may not have been preceded by typing. Direct matching consists simply of mixing the serum of the donor's blood with a suspension of the recipient's cells, and the serum of the recipient's blood with a suspension of the donor's cells, examination being made subsequently to determine whether agglutination has or has not occurred. A simple and perfectly satisfactory method of doing this employs the identical procedure just previously outlined in connection with blood typing, using known blood rather than type sera. In interpreting results for purposes of direct matching, however, the blood type to which either donor or recipient belongs is a matter of complete indifference (Fig. 11). Several other methods of performing the test have been proposed of which only one representative macroscopic method will be described.

B. TECHNIQUE OF MACROSCOPIC MATCHING USING TEST TUBES: The apparatus necessary for the performance of direct

blood matching by the macroscopic method using test tubes consists of the following:

(a) Six very small test tubes (about the size used for the performance of the standard Kahn precipitation test),

(b) Two sterile 2 or 5 c.c. syringes with 22 to 24 gauge needles attached,

(c) A small flask of 1 per cent sodium citrate in normal saline solution (the addition of the citrate to the saline is not absolutely essential if the operator is skilful and rapid in his manipulations),

(d) Two graduated centrifuge tubes,

(e) Serological pipettes (several),

(f) Two small test tubes of about 5 c.c. capacity,

(g) A centrifuge, and

(h) A flask of plain normal saline solution.

The actual test proceeds by withdrawing under sterile precautions 2 or more c.c. of blood from the veins of both prospective donor and prospective recipient. Place 4.5 c.c. of the sodium-chloride-sodium-citrate solution in each of the two centrifuge tubes, label one "Donor" and the other "Recipient," and add to each tube in accordance with the label 0.5 c.c. of the blood withdrawn previously. Expel the remaining blood into the two test tubes, mentioned under "f" above, label "Donor" and "Recipient," and set away to coagulate.

Now centrifuge the contents of the two centrifuge tubes, pipette off, and discard the supernatant fluid; add about 5 c.c. of plain normal saline, mix and centrifuge again. Again pipette. off and discard the supernatant fluid, and make up the bulk to 5 c.c. with plain saline solution. This provides a 10 per cent suspension of the washed red cells of both donor and recipient. Shake the tubes gently to emulsify the contained red cells.

Label the six small test tubes numerically from 1 to 6.

In tube No. 1 place: (a) One drop of the red-cell suspension from the donor

(b) Four drops of the serum from the recipient

In tube No. 2 place: (a) One drop of the red-cell suspension from the recipient

(b) Four drops of the serum from the recipient

In tube No. 3 place: (a) One drop of the red-cell suspension of the donor

(b) Four drops of his own serum

In tube No. 4 place: (a) One drop of the red-cell suspension of the recipient

(b) Four drops of his own serum

In tube No. 5 place: (a) One drop of the red-cell suspension of the donor

(b) Four drops of the red-cell suspension of the recipient

In tube No. 6 place: (a) One drop of the red-cell suspension of the recipient

(b) Four drops of the normal saline solution.

Add to each of the tubes 1 c.c. of normal saline solution, mix gently, and place in the incubator for two hours.

Reading the Results: The last four tubes are, of course, set up merely as controls, and should show neither agglutination nor hemolysis; if such occurs the technique has been at fault.

The first two tubes indicate the presence or absence of compatibility between the two bloods:

(a) Completely compatible bloods will show neither agglutination nor hemolysis in either tube.

(b) Agglutination but not hemolysis in tube No. 2, and neither agglutination nor hemolysis in tube No. 1 indicates that the donor may be used in an emergency.

This method is somewhat more reliable than the shorter technique previously described.

v. The Danger of Inoculating Blood Borne Diseases during Transfusion

It should almost go without saying that when preparing to perform a transfusion due care should be taken to guard

against the possibility of transmitting blood-borne infections, especially syphilis, malaria, and in certain localities, relapsing fever. The danger of inoculating relapsing fever, except in geographical areas in which the disease is endemic, is exceedingly remote. Malaria is inoculated intravenously only with difficulty, even when deliberate attempts are made to do so; but danger from this source is sufficiently great in blood transfusion to render examination of one or more blood films imperative, especially in case preliminary careful questioning of the donor elicits a suspicious history. The danger of transmitting syphilis is very real, and for this reason preliminary serological testing of the donor's blood should be the rule except in dire emergencies. Unfortunately the clinical history of donors is apt to be unreliable with respect to venereal infection, and transmission of lues, even from one close relative to another, during transfusion is by no means unknown.

The advent of the Kahn precipitation reaction has provided a test which need not consume more than half an hour, and which in competent hands is not only remarkably sensitive but thoroughly reliable. Except in the more acute emergencies, therefore, the factor of urgency does not excuse negligence in taking the necessary precautions with respect to syphilis. It is, of course, quite permissible on occasion to transfuse a patient with blood from a syphilitic husband, or wife, or mother, provided that the circumstances are such as to preclude the innocence of the patient.

VI. Whole Blood versus Modified Blood in Transfusion

Direct transfusion is probably almost never used at the present time, partly, (1) because of the technical difficulties involved, and (2) because with such a technique no method is available for accurately determining the amount of blood transfused. Much credit is due the pioneers in the field, however, among whom must be mentioned particularly G. W. Crile,[10] inasmuch as the method of direct transfusion made possible the methods which have superseded it.

The question of the relative merits of "whole blood" versus "modified" blood as an agent in transfusion is one concerning which many surgeons have rather definite and fixed convictions, though it must be added that in answer to this as to many questions much may be said on both sides. On the one hand, better apparatus for whole blood transfusion is being developed from time to time, and on the other, the question as to the action of anticoagulants is being widely debated, and is being made the basis of a large number of experimental investigations.

The use of citrated blood is of considerably more recent development than that of whole blood. Hustin[11] of Belgium, in 1914, was the first to make use of an anticoagulant. He used a glucose and sodium citrate solution and accordingly may be called the father of the "modified blood" method. Agote,[12] in Buenos Aires, performed the first transfusion with blood simply citrated on November 14, 1914.

On *a priori* grounds alone whole blood transfusion would probably be preferred to modified blood transfusion, as the latter involves greater possibilities than the former for the introduction of some undesirable foreign substance along with the blood used, either in the form of particles derived from the walls of the apparatus or in the form of substances dissolved by the blood during its passage over the walls of the apparatus, as well as the certainty of the introduction of the specific foreign substance added to prevent coagulation. The introduction of minute foreign particles in suspension into the blood stream is commonly followed by a reaction which is known as a "nitritoid reaction," because of its resemblance to the effect produced by the exhibition of nitrites. This nitritoid reaction consists of redness of the face, dyspnea, cough, precordial pain and a feeling of general distress.

The danger from this source has been specifically set forth by Galland,[13] who incriminates new rubber tubing as the source of a certain number of cases of nitritoid reaction; presumably particles of the dusting powder present on the surface of new

rubber tubing, used in the construetion of apparatus for trans-
fusion, may give rise to a particulate suspension suflieient to
eause the eondition. The added possibility that rubber tubing
may give off soluble toxie substanees merits eonsideration as well.

A. THE MECHANISM OF BLOOD COAGULATION: Neither
can a rational opinion as to the fundamental value of "whole
blood" versus "modified blood" be formed, nor ean the aetual
performanee of the teehnique of transfusion by either method
be safely performed in the absence of a good working knowledge
of the principles underlying the eoagulation of blood, and, in
the ease of "modified blood" at least, the action of eoagulants
in the prevention thereof.

Coagulation, or elotting, is the process by which blood is
transformed from a free flowing liquid to a more or less solid
gelatinous substance. The proeess itself, mieroscopically,
eonsists of crystallization of fibrin from the fibrinogen of the
blood plasma. The mechanism of this erystallization may be
eonsidered from two general viewpoints: the first, mechanieal
or physieal, and the seeond, ehemieal.

Tait and Burke[14] have given a classieal deseription of
physical coagulation as it is observed under dark field illu-
mination. Aeeording to these observers, the first stage of the
process consists of an adherence of the platelets to the surfaee
of the glass slide. This stage is followed by a seeond stage
charaeterized by irregular swelling of the platelets with spher-
ule formation about the swollen margins thereof; a third stage
follows this, in whieh disintegration of the platelets oeeurs,
with migration of the aforementioned spherules out into
the plasma. During this proeess of migration a progressive
diminution in the size of the spherule takes plaee to the
vanishing point, and a strand of fibrin appears along the path
traveled by each of the spherules. Tait and Burke have also
shown that blood whieh has been virtually deplatized, when
allowed to stand under the same conditions, fails to elot. They,
therefore, conclude that the only blood elements eoncerned in
mammalian blood coagulation are the platelets.

This process can be shown to be stimulated by the passage of the blood over a rough surface and inhibited by the substitution of a smooth surface for the rough one. Furthermore, the greater the length of surface traversed by the blood, other things being equal, the more rapidly will it coagulate. Blood coagulates more slowly at a low temperature than it does at a high temperature, this being one of the indications that blood coagulation is a true chemical process.

Chemically, the process of coagulation is not thoroughly understood, although the fundamental facts have been known for a number of years. These are, briefly:

(1) Fibrin is formed by the action of thrombin upon fibrinogen, fibrinogen being a normal protein constituent of the circulating blood.

(2) Thrombin, however, is not a normal constituent of the circulating blood, but is formed presumably by the destruction of white blood cells in the presence of available calcium.

(3) The hypothetical substance which reacts in the presence of calcium to form thrombin has been named prothrombin.

B. THE RÔLE OF SODIUM CITRATE IN "CITRATE TRANSFUSION": Any substance which will prevent the completion of this outlined cycle of events, will prevent coagulation. The chemical agents most useful in preventing coagulation interrupt the cycle in the prothrombin stage, by rendering available calcium unavailable. Sodium citrate, the common anticoagulant used in blood transfusion, forms with the calcium of the blood stream a double salt, in a manner not well understood, and as a result of this process calcium is rendered unavailable and thrombin is never allowed to form. Microscopically, sodium citrate preserves the platelet intact.

It has apparently been demonstrated that sodium citrate in the amounts used for ordinary blood transfusions does not exert any proved harmful effects whatever on the human organism. To be sure it was asserted,[15] on the basis of certain experiments performed several years ago, that sodium citrate (1) renders the red blood cells more fragile, (2) diminishes the

available quantity of complement, (3) reduces the opsonic index almost to the vanishing point, and (4) practically destroys the phagocytic power of the white cells;[15] but a repetition of the experiments on which these conclusions were based by Mellon, Hastings, and Casey[16] has been made without in the least confirming the original findings.

Salant and Wise[17] have shown that sodium citrate is very rapidly eliminated from the body partly by the kidney unchanged (30 to 40 per cent) but more especially by oxidation in the tissues, 90 per cent of the salt being eliminated by the combined methods within a period of ten minutes. According to Lewisohn,[18] as much as 5 gm. of sodium citrate may be given in the form of a 0.2 per cent solution without causing any harmful effects; this latter amount is sufficient to take care of $2\frac{1}{2}$ l. of citrated blood, an amount five times as large as is given in an ordinary transfusion.

Gichner[19] attacked the problem of the action of sodium citrate upon the platelets by means of the ultramicroscope. He discovered that the platelets were not injured by the concentration of citrate commonly used for purposes of transfusion as evidenced by the fact that if calcium salts were resupplied to the citrated blood, either by means of treating it with a soluble calcium salt or by dialyzing out the citrate through a celloidin sack, the platelets behaved in a perfectly normal manner. Whether citrated platelets act the same in the body as they do under the microscope is, of course, a question, but perhaps no more so than is the question raised by Gichner whether even in whole blood transfusion the mere traffic of platelets over the surface of the tube connecting the donor with the recipient may not seriously injure them.

Rosenthal and Baehr[20] believe that platelets once exposed to the action of sodium citrate are speedily removed from the circulation, for they have observed that a paradoxical shortening of the coagulation time occurs after the administration of sodium citrate intravenously. They explain this on the basis of the theory that the citrate causes the platelets to lose thrombo-

plastic substance during the process of disintegration. This is, of course, entirely theoretical.

When all is said and done, there is no real evidence to sustain the argument that sodium citrate is harmful to the body economy either directly or indirectly, and its use over a period of several years in many thousands of cases has lent strength to the argument against its supposed toxicity.

C. POST-TRANSFUSION REACTIONS: Reactions occur following the use of citrated blood more frequently than following the use of whole blood; the percentage incidence of reaction varies with different observers and in different hands all the way from 0 to 8 per cent in the case of whole blood and from 13 to 50 per cent in the case of citrated blood. Many observers are inclined to lay the blame for the higher percentage of reactions when using citrated blood at the door of the citrate, but as previously noted, there is little direct evidence to substantiate such a view, and furthermore, there is some reason for incriminating technique rather than method. This subject has received especial attention in the writings of Lewisohn,[18] Lederer,[21] Kretzler,[22] and Pauchet.[23]

Excluding sodium citrate from consideration, the graver incidence of marked reactions following the use of citrated blood in transfusion may be explained, provisionally at least, as due to the fact that in the indirect method there is a greater tendency to use a careless technique, and, therefore, there is a greater opportunity for the blood to become contaminated. Whole blood transfusion has been considered, certainly up to a very few years ago, and probably is still considered, a fairly formidable undertaking, individuals with some special training alone being considered competent to use the method, individuals who, presumably, appreciate the necessity for absolute cleanliness of receptacles and other requisites of a good technique; whereas indirect transfusion by the citrate method is likely to be undertaken by almost any one, at almost any time, and in the treatment of an individual debilitated to almost any degree, the utensils used being in many cases

utensils which have been previously used for other purposes, and part of the technique at least being entrusted to individuals not entirely competent in all particulars.

In addition to the action of sodium citrate various other factors have been suggested as possible causes of untoward reactions, especially the chilling of the blood in transit from donor to recipient, the breakdown of the cellular elements of the blood consequent upon too vigorous stirring, and the presence of minute blood clots or air bubbles due to faulty technique in manipulation, as well as the possibility of contamination from glassware and rubber tubes as previously mentioned.

Post-transfusion reactions may be mild or severe, and probably a considerable part of the discrepancy in the reported incidence of such reactions arises from the fact that the criteria upon which they are recognized have not always been clearly stated. It has been held by some that a post-transfusion reaction includes not only some elevation of temperature, but some other definite sign, such as, vomiting, chill, urticaria, dyspnea, jaundice, or hemoglobinuria.

Using such a criterion, Brines[24] reported a series of 2500 transfusions of unmodified blood with only three severe post-transfusion reactions; in two of these latter cases cyanosis, coma, and convulsions were noted. Others believe that a significant increase in the patient's temperature even in the absence of any other symptom or sign is sufficient evidence of reaction. Certainly the usual evidences of reaction are pyrexia and chills, the common range of temperature rise being of the order of magnitude of 2 to 3°F.; nausea, vomiting, and the other signs previously mentioned characterize only the more severe types. Reactions when they do occur, by whatever method, are usually not severe and in the vast majority of cases call for no active treatment; the only treatment that can be provided even when active interference seems to be indicated is entirely symptomatic in the present state of our ignorance as to the exact etiology involved. Fundamentally the treatment is, of course, prophylactic.

D. THE VIABILITY OF TRANSFUSED ERYTHROCYTES: Formerly the teaching was that the life of a transfused red corpuscle was not more than from ten to twenty days, and this estimation was based on the *per diem* excretion of bilirubin with respect to the total volume of circulating bilirubin in the red blood cells. More recent methods, making use of knowledge of the so-called "groups" of blood donors, has enabled the making of much more accurate estimations; and it is now considered that a transfused red blood cell is viable for at least from thirty to eighty-three days. The blood count subsequent to transfusion sometimes shows a count increased, sometimes stationary, and sometimes decreased.

VII. THE TECHNIQUE OF BLOOD TRANSFUSION

The technique of blood transfusion has proved a very intriguing subject for experimentation, and the considerable number of pieces of apparatus which have been devised for purposes of transfusion, as well as the ingenuity shown in the construction of the various mechanical devices now marketed by instrument houses, is rather remarkable. Naturally, the technique of whole blood transfusion has been made the subject of particular investigation, because in the use of whole blood the prevention of coagulation depends more particularly upon mechanical considerations, and expedition in the actual transfer of the blood from donor to recipient becomes a matter of considerable importance.

A. WHOLE BLOOD TRANSFUSION: No attempt will be made to discuss comprehensively the various special pieces of apparatus commonly used in the performance of whole blood transfusion. Almost any of the better known of these present certain features of theoretical or practical interest, and success in the use of most of them depends more upon individual preference, manual dexterity, and practice than upon any particular superiority in design.

Two particular methods will, however, be described, either of which, with a little practice, can be used satisfactorily,
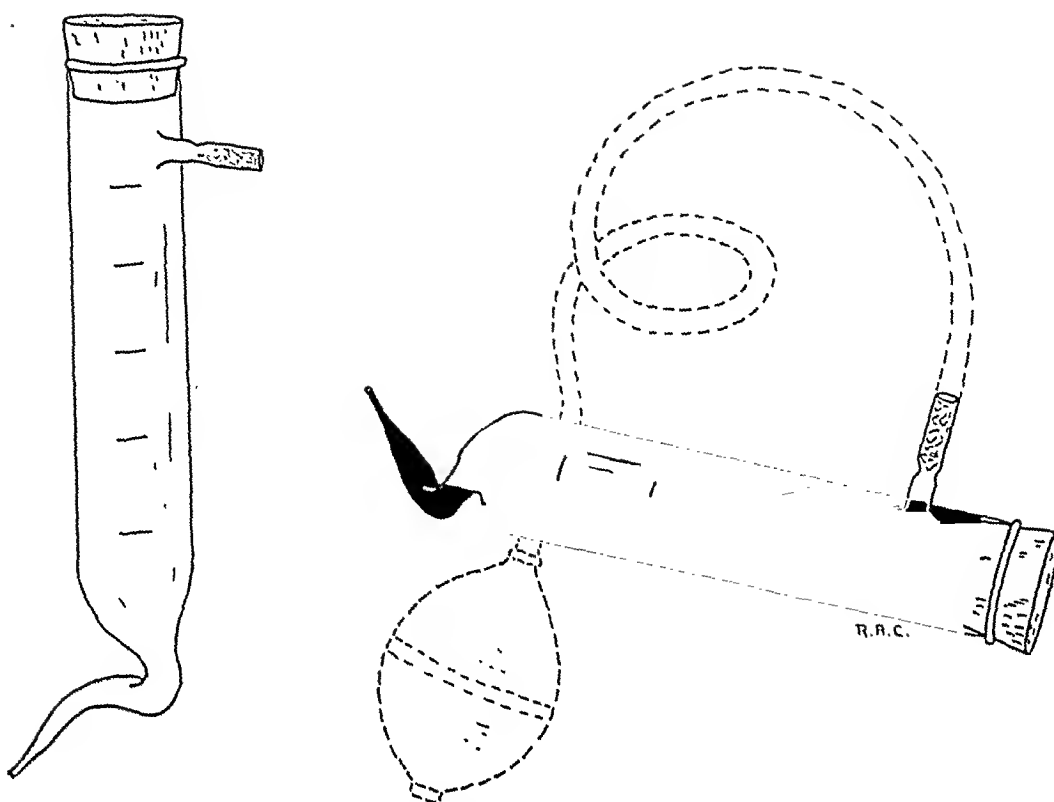
FIG. 12. Mechanical characteristics of original Kimpton-Brown tube. Tube consists of glass cylinder of any capacity desired; it is closed at upper end with cork stopper, is drawn out at lower end into a cannula, and is provided in its upper portion with a side arm.

In practical operation the tube was sterilized in an autoclave. Before being autoclaved a small piece of pure clean paraffin wax with a melting point of 50° C. was placed in the tube, and the cork was inserted; the tube was then wrapped carefully in a towel. Before use tube was removed from sterile wrapping and held over Bunsen burner, an alcohol lamp, or any other suitable source of heat and was revolved until all portions of inside surface were thoroughly coated with a thin film of paraffin. The excess of paraffin was then allowed to drain away onto a sterile gauze sponge held against tip of cannula. Thereafter, paraffin coating was made to set as rapidly as possible in order to avoid crystallization by bringing outside of tube into contact with hands. Insertion of a piece of absorbent cotton into side arm completed preparation.

Blood was obtained by exposing and cannularizing an artery of donor. When as much blood had been collected in the tube as was desired, tube was removed and placed in second position shown here, in order to prevent spillage of blood. Cannula was then inserted into previously exposed vein of recipient and was forced into his circulation by a Paquelin cautery bulb pump attached to side arm of apparatus.

[601]

and both of which are believed to possess certain features of importance not possessed to a similar degree by any other method. The first method is included in the text because,
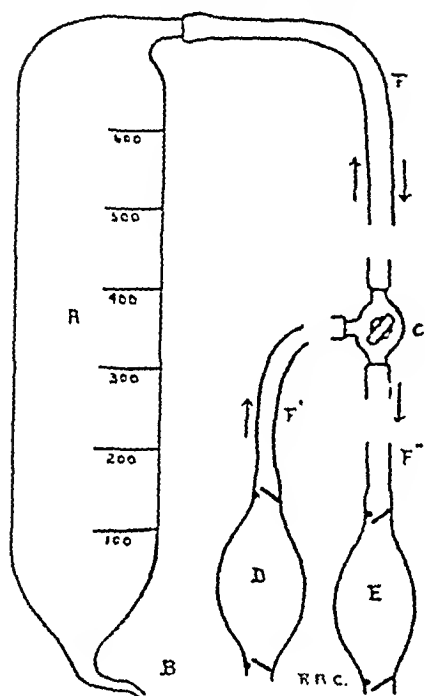
FIG. 13.   FIG. 14.

FIG. 13. Percy tube. A is the tube itself; it terminates in the cannula B. F is a piece of flexible rubber tubing which leads to the threeway cock C. F″ and F′ are pieces of flexible rubber tubing which lead respectively to the pressure bulb D and the suction bulb E.
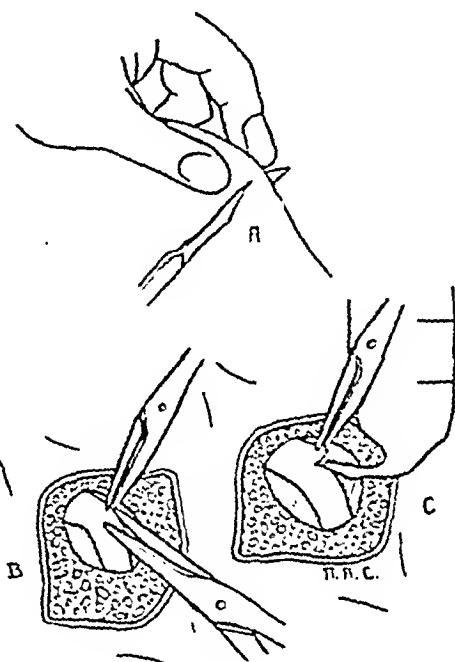
FIG. 14. Simple method of introducing the cannula of the Percy tube. A, a fold of skin over the chosen vein is picked up between thumb and index finger of left hand and transfixed with sharp scalpel held in right hand; scalpel completely divides fold of skin. B, the vein is exposed by dissection, is held up by a fine pointed forceps which barely grasps the wall of vessel, and is incised on the slant with pointed scissors. C, the vein wall is still held in the forceps, and the point of the cannula is being introduced into slit previously made by scissors. In the interests of simplicity ligatures are not shown.

though technically not easy, it is believed to deliver blood from donor to recipient in as nearly an intact condition as is physically possible when using an indirect method. The second method is included because it is believed to be the simplest one making use of the principle of valvular action. It must be understood that the selection of these two techniques is meant

to cast no unfavorable reflection upon any other methods, and that the technique of greatest value to the individual operator must be the one which after adequate trial proves most efficient in his own hands, whether it be one of those now to be described or some other.

1. *The Technique Using the "Percy Tube": a.* The actual transfusion: The "Percy tube" is a modification of the original Kimpton-Brown tube (Fig. 12). It consists of a large, paraffin-coated, cylinder constructed of resistance glass which is drawn out at the bottom to form a cannula for insertion into a vein and at the top is connected with a threeway valve and a system of rubber tubes and bulbs by means of which either suction or pressure may be applied to the interior of the tube at will (Fig. 13).

The method requires formal dissection of a vein of both donor and recipient, and this is the most serious objection to the technique. The skilful operator, however, will usually be able to perform the necessary operative manipulations through a very small incision on the arm which will give rise to a minimum of immediate discomfort and subsequent scarring (Fig. 16). Not infrequently the veins of the recipient are in so collapsed a condition that formal dissection of these is necessary when using any technique whatever, and in any case, the formal dissection of a vein for purposes of transfusion is not likely to occasion serious objection except in cases in which it must be undertaken repeatedly, as in the case of professional donors. When professional donors are involved especial care should, of course, be taken to avoid unduly large incisions, and veins high on the forearm or even on the arm should be chosen first since veins must be conserved insofar as possible.

The arms of both donor and recipient are draped in the ordinary case as for any minor operation on the antecubital fossa, and a tourniquet is adjusted about the upper arm sufficiently tightly to occlude the venous return from the forearm without at the same time embarrassing the arterial

FIG. 15. Percy tube. Note graduations on tube, peculiar s-shaped bend of glass tubing at bottom, and tapering point of cannula. This apparatus is provided with a pressure bulb and a suction tip; the latter is placed in the mouth.

circulation. The cuff of a blood pressure apparatus serves as an excellent tourniquet, and possesses the especial advantage that the pressure exerted by it can be accurately adjusted and
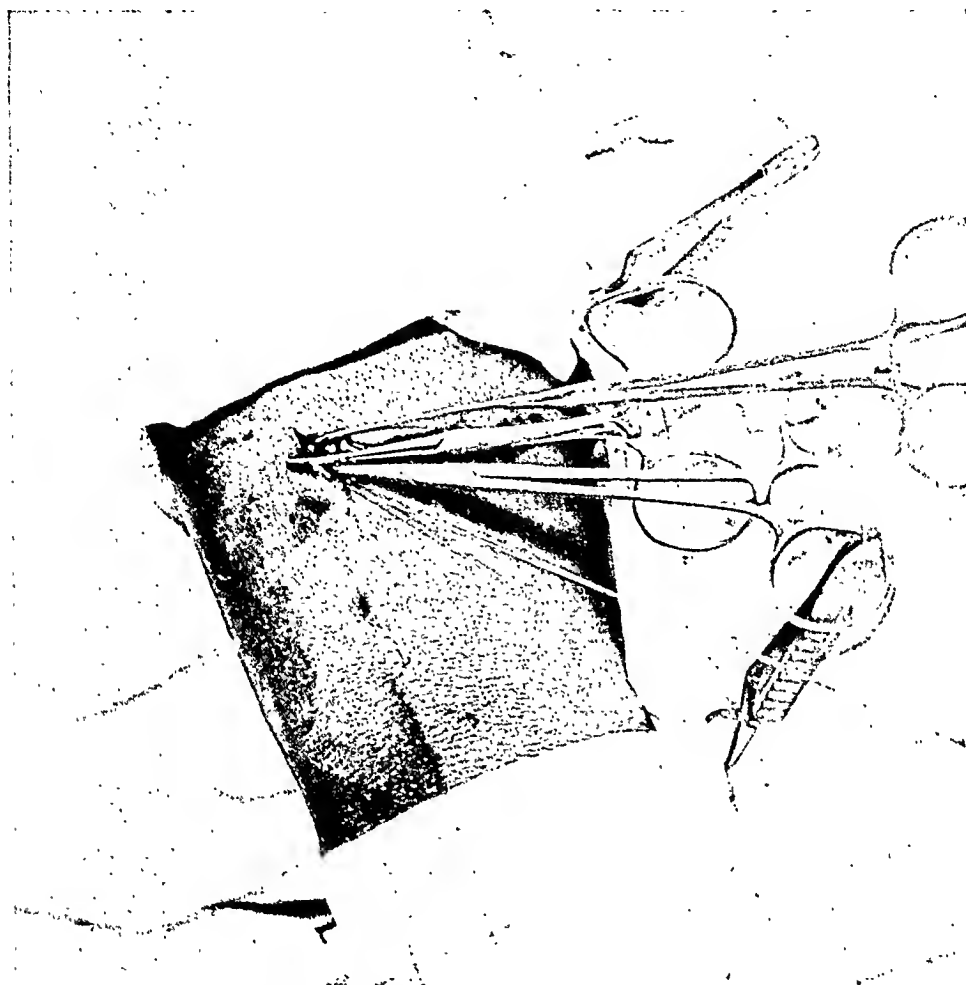
FIG. 16. Skilfully performed dissection of a vein at bend of elbow. Note small size of incision and character and disposition of instruments.

readjusted as desired under the control of manometric readings. By means of a hypodermic syringe and a fine needle a skin wheal is now raised over a suitably prominent vein, using 0.5 per cent novocaine solution as an analgesic; about 1 c.c. of the solution is thereafter deposited subcutaneously about the vein, care being taken to avoid puncture of the vein itself. After one has waited a minute or two for the novocaine

to take full effect the vein is exposed by making a ½ to ¾ in. incision through the skin with a sharp knife and the vein is dissected free from surrounding subcutaneous tissue either with the points of a Mayo scissors or with a suitable blunt dissector. A ligature of No. oo plain catgut is now tied tightly about the vein in its most distal portion in the case of the recipient and in its most proximal portion in the case of the donor. A pair of rubber covered clamps are also applied to the vein at a distance of about ¾ in. from the ligature either proximal or distal as the case may be, and the vein is opened between ligature and clamp to receive the cannula of the Percy tube. The veins of donor and recipient are both similarly prepared before any attempt is made to proceed with the actual transfusion.

The Percy tube, sterile and properly coated with paraffin, is now taken in hand and while held upright is allowed to dip into a beaker containing sterile paraffin oil; at the same time an assistant produces suction within the tube by manipulation of the suction bulb or suction tip with which the apparatus is provided. About an inch of paraffin oil is thus drawn into the tube.

The tube is now ready for insertion into the vein of the donor. The point of the cannula is introduced into this vein so so as to point distally, care being taken not to strip the endothelial lining of the vein away from the overlying tunics during the process. No ligature is tied about the cannula, but reliance is placed upon the pressure with which the tube is held against the opening in the vein to prevent leakage of blood. The rubber covered clamp is now removed, and the Percy tube should immediately begin to fill with venous blood. As soon as the flow of blood into the tube becomes retarded due to back-pressure of the accumulating column of blood gentle suction is applied to the interior of the tube by an assistant manipulating the suction bulb or suction tip of the apparatus. In this manner as much blood as desired is withdrawn from the donor. Care should be taken that not too much suction is ever applied

to the tube because the wall of the vein is, of course, thin, and it is easily possible to collapse it about the point of the cannula in such a way as completely to prevent further ingress of blood.

As soon as the required amount of blood has been obtained the valve controlling the suction and pressure tubes is turned to the "pressure" position for a moment in order to relieve any undue residual suction that may be present and then to the "off" position; the Perey tube is now removed, previously having again applied the rubber covered clamp to the vein to prevent subsequent leakage of blood. No time should now be lost in introducing the cannula of the instrument into the recipient's vein because undue delay may lead to clotting of the blood in the apparatus, and the entire transfusion may be thus lost. The cannula is inserted, this time with its tip toward the heart, the rubber covered clamp is removed as previously, and the valve controlling the suction and pressure tubes is turned so that pressure can be exerted on the column of blood. Little pressure is usually required when injecting blood, because it is not desirable to force blood rapidly into the vascular system of the recipient for fear of the production of cardiac dilatation or circulatory embarassment (Fig. 18).

When the meniscus between the column of blood and the supernatant layer of liquid paraffin has come into the constriction at the bottom of the Perey tube, the rubber covered clamp is again applied to the vein, and the apparatus is removed. The operation is completed by tying a ligature securely about the veins of both donor and recipient in the position formerly occupied by the rubber covered clamp, removal of the clamp, and suture of the overlying skin with one or two suitable sutures.

b. The preparation and care of the Perey tube: The preparation of a Perey tube for subsequent use should commence immediately after its use by a preceding patient. As soon as the cannula of the tube has been withdrawn from the vein of the recipient it is handed to an assistant who takes it to the sink and washes it thoroughly, first in cold water and then

in hot water, by alternately drawing up and expelling the water by means of the suction and pressure bulbs. This procedure serves not only to wash the tube clean of all blood, but

Fig. 17. Withdrawal of blood.

the heat of the hot water serves also to wash out most of the paraffin coating; the last remnants of the paraffin are now removed, by drawing up and expelling first alcohol and then ether in the same manner as the water was previously drawn up and expelled. When the last traces of the ether have

evaporated the tube is ready for resterilization and recoating; this is done by means of dry heat over the flame of a Bunsen burner. The tube, being constructed of resistance glass, can

FIG. 18. Blood being administered; an assistant is aiding gravity by pressure on pressure bulb. Note tube itself is sterile, but pressure and suction apparatus is not.

FIGS. 17 and 18. Percy tube in use. Note relative size of tube by comparing it with size of operator. Note paraffin oil floating on top of column of blood.

be sterilized in this manner without danger of cracking. The tube, being held by its upper end, after the rubber tubing has been removed, is passed back and forth through the flame

throughout as much of its length as is feasible until so thoroughly and completely heated that all bacteria have certainly been destroyed in the process; if any doubt exists on the latter point, the process may be continued until the glass actually glows, though this is hardly necessary. The tube is now allowed to cool slightly, after which the sterilized end is grasped in the folds of a sterile towel, and the end previously held in the hand is similarly sterilized by being passed through the flame. While the tube is still hot the rubber suction and pressure system is re-attached without contaminating any part of the tube, except the part which actually makes contact with the rubber, and sterile paraffin, which has in the meantime been boiling for the purpose, is sucked up into the tube and immediately re-expelled. The tube is now allowed to cool without contamination, being twirled, if desired, in front of an electric fan to hasten the cooling process, until the thin film of paraffin which remains on the inside has set, whereupon it is dropped into a sterilized canvas bag, the mouth of which ties securely about the constricted upper part of the tube, and the entire apparatus is wrapped in a towel to be put away until needed.

Before one attempts to use a tube, it is important to make sure that the lumen of the cannula is patent and not plugged with paraffin. If it should be found plugged, the condition may be remedied not by attempting to clear the lumen with a pin or needle, a procedure which will almost certainly denude part of the wall of its paraffin and at all events break the wax, but by reheating the tip of the apparatus over a flame until the wax flows and reestablishes the lumen.

Percy tubes may be coated with paraffin dissolved in a solvent instead of by the method just described, the solution of paraffin being drawn into the tube cold, allowed to coat the sides thoroughly and then to set as a result of the evaporation of the solvent; but the coating thus obtained is friable and unsatisfactory.

When transfusion by the Percy technique is performed with a moderate amount of skill such as can be acquired rather

readily by almost anyone having a mechanical turn of mind, about the only injury which the formed elements of the blood could receive would result from such slight chilling as might occur. Chemically and mechanically it is difficult to see how much change could possibly occur during the transference of the blood, since at no time does the blood come into contact with the air, or indeed with any other substance except paraffin, which is not only smooth but chemically inert. Under the conditions of the Percy technique coagulation of the blood can occur only in cases in which some mechanical difficulty prolongs the operation for a considerable length of time. The operator can count on at least ten minutes in which to complete his transfusion, about seven minutes being allowed for the withdrawal and three minutes for the injection of the blood, and in many cases nearly twice this length of time can be allowed to elapse with impunity. The danger of coagulation, however, this method shares with all other methods of whole blood transfusion, though in a unique manner because there is a very real danger when using such a method of losing the entire transfusion.

2. *The Jubé Method of Whole Blood Transfusion:*[25] The second method of whole blood transfusion now to be described embodies the use of (1) a relatively small syringe by which suction and traction can be made, i.e., by which blood may be alternately withdrawn from the donor and injected into the recipient, (2) a system of tubes and needles for connecting donor with recipient, and (3) a control valve which regulates the direction of the flow of the blood so that the blood travels in the system always in the same direction, i.e., from donor to recipient, without necessitating the disconnection of any part of the apparatus.

Several different models of instruments, embodying these same essential features and known by the name of their respective designers, are produced commercially and are in more or less constant use by smaller or larger groups of practitioners. The particular piece of such apparatus, selected from

this group of instruments and about to be described, is chosen not because it is necessarily more satisfactory than the others in actual use but because of its extreme simplicity in design.
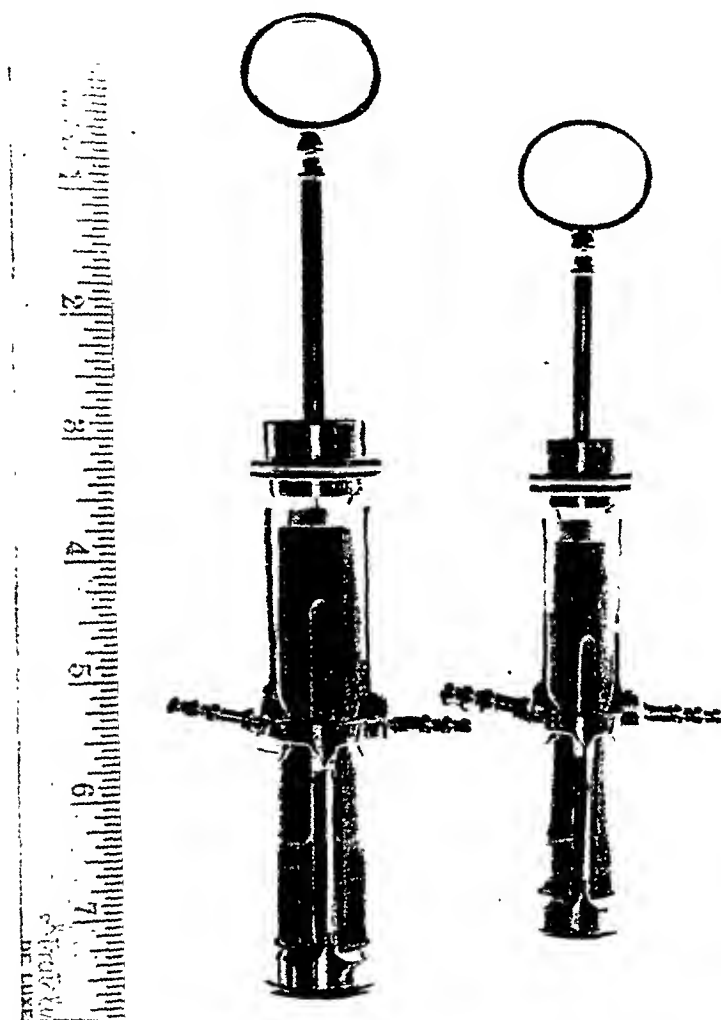
Fig. 19. Relative sizes of 5 c.c. and 10 c.c. Jubé syringes. Note quality of workmanship and absolute size of instruments as shown by ruler.

The essential features of the mechanism will be readily seen by referring to the photographs. The syringe used is constructed partly of metal and partly of glass and serves the function not only of syringe but also of a control valve, the

valvular action being provided by rotating the plunger. The syringe barrel is made of glass; it terminates not in an attachment for a needle as does the ordinary hypodermic syringe
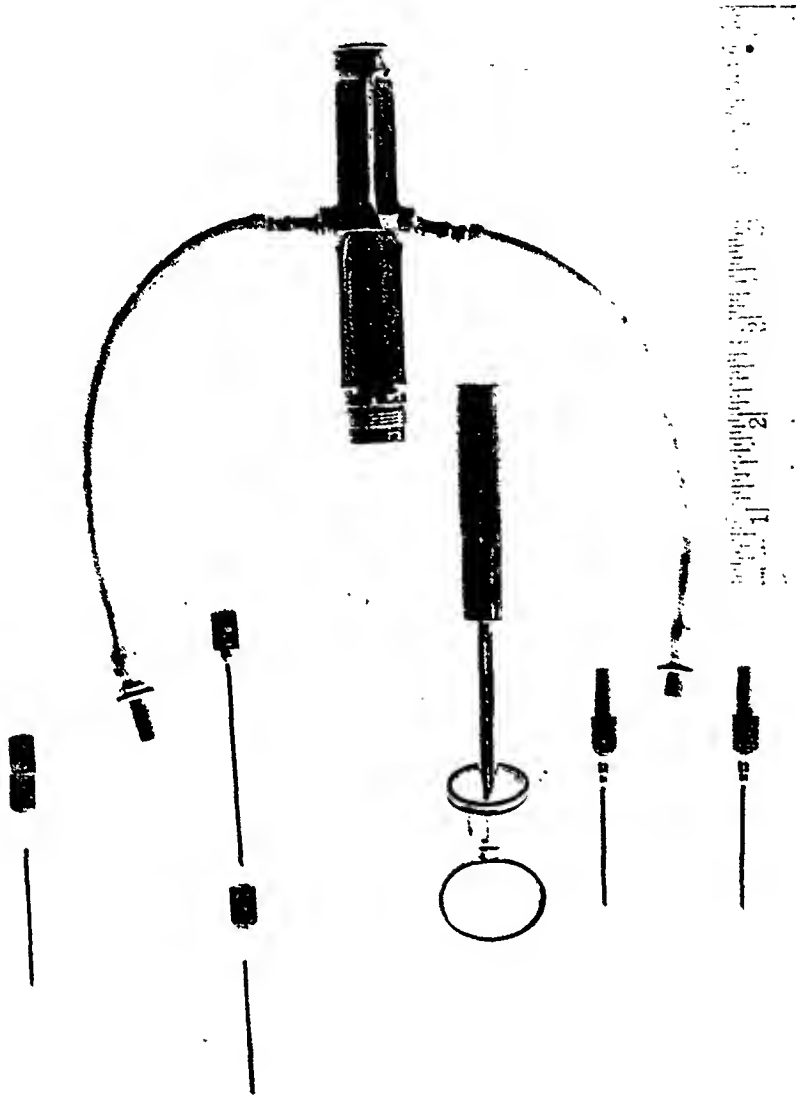
Fig. 20. Jubé syringe disassembled, but with rubber side tubes in place. Note groove in plunger of syringe and screw cap which joins plunger assembly with syringe barrel. Only barrel of syringe is made of glass.

barrel but ends blindly in a solid metal cap; it further differs from the ordinary syringe barrel in that it is provided in its midportion with two holes which are placed· at the same

level and diametrically opposite each other. These holes communicate with the lumina of two tubular metal side arms which are cast in a metal collar, this part of the apparatus being slipped over the glass barrel during the process of manufacture and being subsequently set in place permanently with cement. The other end of the barrel is also of metal and is provided with a screw cap through which the plunger-rod passes. The plunger is of solid metal and differs from the plunger in an ordinary hypodermic syringe only in that it is provided with a longitudinal groove which extends from its distal end to the junction of its middle and proximal two-thirds. This groove is of the same width as the holes in the sides of the barrel previously described, and when the plunger is within the barrel, can be rotated at will so that it overrides either of the two holes. Attached to the sidearms of the syringe barrel are two 6 in. lengths of pure gum rubber tubing each of which terminates in a needle adapter and needle. One of the needles is introduced into a vein of the donor, the other into a vein of the recipient.

The action of the apparatus is very simple. The plunger of the syringe, being introduced to its fullest extent, is rotated until its groove is directly over the lumen of the side-arm leading to the donor. Withdrawal of the plunger is now started, thus instituting suction at the far end of the barrel. This part of the barrel being in free communication with the side-arm, tube, and needle of the donor, because of the channel afforded by the groove in the plunger, suction is exerted upon the blood in the donor's veins, and the syringe gradually fills. Once the syringe is full, the plunger is rotated through an arc of 180°, which motion brings the groove opposite the side-arm connecting with the recipient's tube and needle. Pressure is now exerted on the plunger, and this motion displaces the blood from the syringe barrel again along the groove, this time, however, in the opposite direction, into the donor's side of the apparatus and so into the donor's veins. As soon as the syringe barrel is empty, the plunger is again rotated through an angle of 180° to its original position and

the cycle of events is repeated. In this manner as much blood as is desired may be accurately measured and transferred from donor to recipient (Fig. 21).
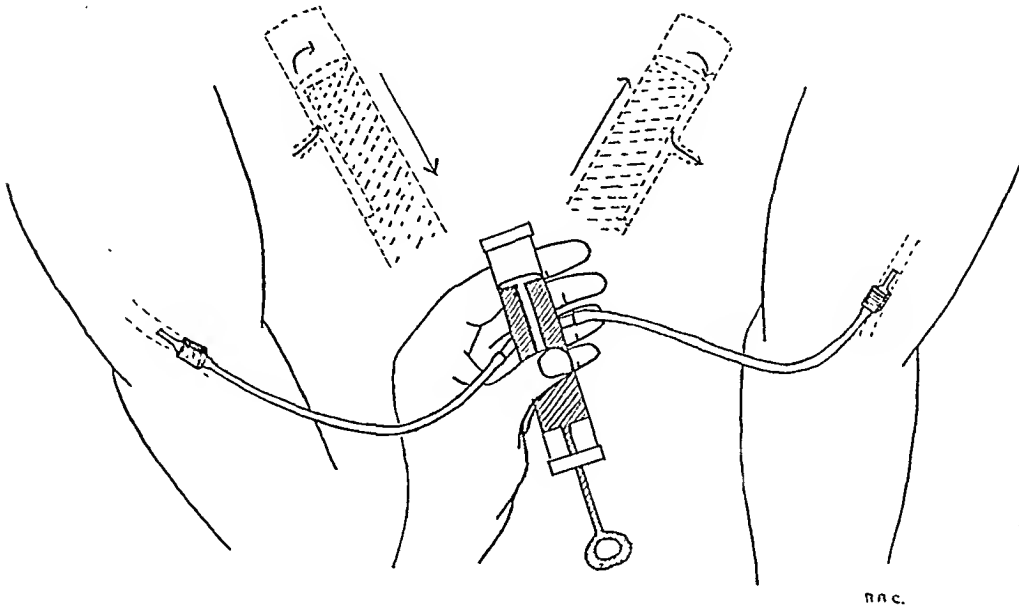
FIG. 21. Valvular action of plunger of Jubé apparatus. Reproduction of apparatus in solid lines represents apparatus in "neutral position": groove of plunger overlays neither of two side tubes, and in this position the plunger can neither be depressed nor withdrawn. Inserts in broken lines represent working positions of plunger. On left is illustrated sequence of events when blood is being withdrawn from donor; traction is exerted and syringe barrel fills. On right is illustrated action of apparatus during injection of blood into recipient; plunger has been rotated through angle of 180°, and in this position pressure exerted on plunger forces blood out of apparatus.

In practice the apparatus is sterilized by autoclaving, by boiling, or by soaking first in alcohol and then in ether. Two sizes of syringe are available, one containing 5 c.c. and the other 10 c.c. Both sizes are quite practicable, but the smaller one is usually preferred, partly because it is more convenient to transport and manipulate and partly because its capacity is such that the column of blood is kept moving rather rapidly; such rapid moving of blood tends, of course, to prevent both coagulation and unnecessary chilling.

In order to put the apparatus into operation the donor and recipient are placed side by side, and the antecubital fossae of the contiguous arms are sterilized. The hands of

the operator are scrubbed, treated with alcohol and covered with sterile rubber gloves. The operator now connects the apparatus completely and makes certain that all parts are in working order and that the needles and tubes are quite patent. Sterile paraffin oil may or may not now be used to lubricate the entire apparatus. The paraffin oil is not necessary to the proper working of the apparatus, though it undoubtedly does tend to prevent coagulation of the blood in that it provides the interior of the entire apparatus with a thin, smooth, chemically inert coating, and it also lubricates the piston of the syringe and thus makes the apparatus work much more easily. The disadvantage of the use of such a substance is the danger of injecting some of the oil into the veins of the recipient and thus producing an oil embolism. With due care such an event can be almost certainly avoided as far as gross oil droplets are concerned, though the possibility of introducing minute droplets even when using a most careful technique cannot be denied. From the practical point of view untoward reactions from this source are certainly not common. The apparatus is most conveniently coated with paraffin oil by pouring sterile oil from a previously sterilized glass ampoule into the barrel of the syringe, inserting the plunger, and then squirting the oil first through one side-arm, tube, and needle, and then through the other.

The apparatus may now be cleared, if desired, with sterile physiological saline solution by introducing the tip of one of the needles into a container of this solution and then pumping the solution in through this needle and out the other needle precisely as is done when blood is used and the actual transfusion is in progress. The system may be allowed to remain full of this solution, if desired, and in this case the first excursion of the plunger in the actual transfusion injects saline solution rather than blood.

The actual transfusion proceeds with the tightening of a tourniquet about the upper arm of the recipient sufficiently tightly to occlude the venous return without at the same time

embarrassing the arterial blood flow, and the introduction of a trocar and cannula into one of the prominent veins at the bend of the elbow. The trocar and cannula used are illustrated
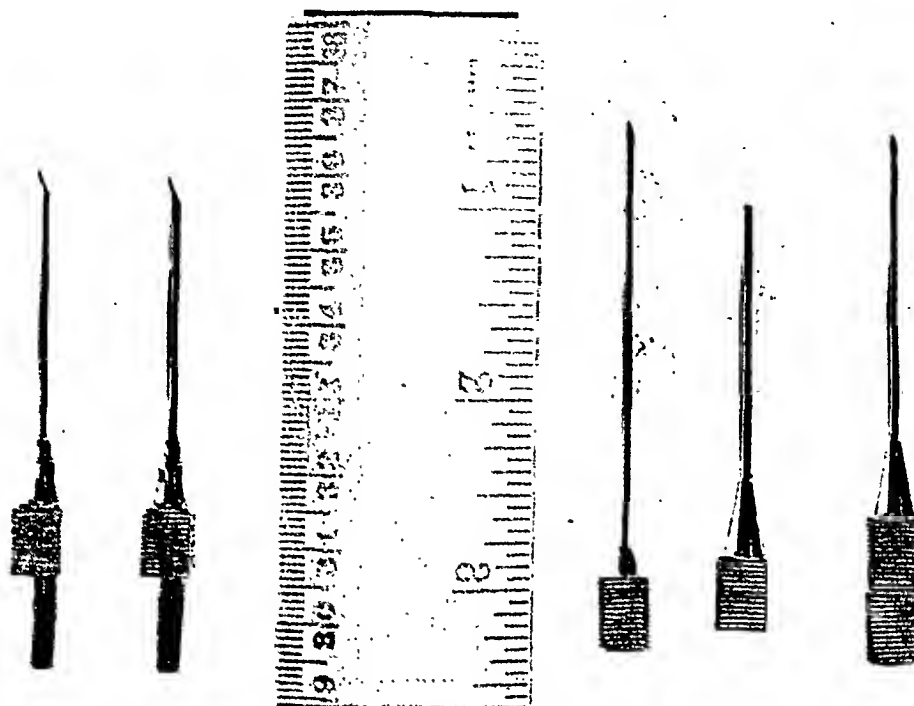
FIG. 22. Jubé needles and cannulae. To the left of the ruler the two sizes of needle used in withdrawing blood from the donor. At the right of the ruler the trocar and cannula for transfusing the recipient. Viewing this part of the figure from left to right are the trocar, the cannula, which it fits, and the assembled trocar and cannula.

in the photograph; a comparison with the ruler illustrated in the cut will indicate the sizes provided (FIG. 22). The trocar and cannula are inserted attached, but once the point of the trocar has located the lumen of the vein, the trocar may be slightly withdrawn, so that the sharp point does not project beyond the tip of the cannula and the latter may then be introduced as far as necessary into the vein without danger of penetrating the opposite wall. The trocar is now left in place in the cannula as an obturator.

Attention is now directed to the donor. The apparatus with ordinary hollow needle attached to the donor's side-arm and tube is grasped all in one hand. A tourniquet is fastened about

the upper arm of the donor, and the needle is thrust directly into one of the prominent veins in the antecubital fossa. As soon as the wall of the vein has been penetrated and the point of the needle lies free within the lumen of the vein, blood will flow into the system and will very soon make its appearance in the syringe provided that the groove in the plunger is placed in the proper position.

If paraffin oil has been used and saline solution has been drawn into the syringe previously, as already suggested, air bubbles and oil bubbles will have been displaced from the syringe and connecting system during the process, and the apparatus will now be ready for attachment to the cannula in the vein of the donor. If oil alone has been used, blood must be pumped through the apparatus to rid it of air bubbles and oil droplets. If the syringe has been used dry, naturally the only necessary consideration is the complete expulsion of air. In the latter cases a small amount of blood will be wasted.

Assembling the apparatus is completed by withdrawing the trocar from the needle in the donor's vein and rapidly attaching to it the needle adapter attached to the free piece of rubber tubing. The transfusion proceeds, as previously described in connection with the description of the mechanical principles involved, by alternately filling and emptying the syringe with blood, always rotating the plunger through an angle of 180° after each half of its cycle.

By the use of this apparatus blood can be transfused as rapidly as with any method making use of the principle of valves. The rate at which the plunger can be manipulated varies not only with the skill of the operator but with the size of the donor's vein and the activity of the circulation in his arm. Each complete excursion of the plunger of the 5 c.c. syringe will ordinarily occupy a period of time varying from three to ten seconds. In other words, when one uses this method, 5 c.c. of blood can be injected every three to ten seconds, or from 30 to 100 c.c. every minute. Coagulation of blood does not ordinarily occur to an extent sufficient to

embarrass the action of the apparatus for at least ten minutes, and such a length of time is amply sufficient for the transfusion of 500 c.c. of blood in all but very difficult cases.

When this apparatus is used a certain small amount of fibrin will usually be found clinging to the barrel of the syringe after the transfusion has been completed. This occurrence is unavoidable and need occasion no concern. Many other types of apparatus making use of the same general principle allow coagulation to occur so rapidly that the system must be frequently washed out with saline solution in order to permit its further functioning at all; the apparatus under discussion is singularly free from this difficulty.

B. THE TECHNIQUE OF THE CITRATE METHOD OF BLOOD TRANSFUSION (LEWISOHN): Minor variations in the technique of citrated blood transfusion are made by almost all operators. The following description is offered merely as a representative technique. For the performance of this type of transfusion the following sterile apparatus is required:

(1) An outfit such as is frequently used for the giving of salvarsan and consisting of a graduated cylinder of at least 500 c.c. capacity connected at the bottom with about 4 ft. of rubber tubing which in turn terminates in a needle adapter; a piece of glass tubing should be interpolated in the rubber tubing about 12 in. from the needle adapter to serve as an observation window.

(2) A graduated glass jar of 500 c.c. capacity with a pouring lip.

(3) A graduated 100 c.c. cylinder with a pouring lip.

(4) A glass stirring rod with smooth rounded ends and long enough to reach from the bottom of the graduated glass jar mentioned under (2) to well above its upper edge.

(5) 100 c.c. of a 2 per cent solution of sodium citrate in distilled water; "chemically pure" sodium citrate should be used (no free lead or iron) and the solution should be freshly prepared.

(6) A needle of 10 to 14 gauge.

(7) A needle of 16 gauge to fit the needle adapter of the salvarsan apparatus, mentioned under (1).

(8) Rubber gloves.

(9) A 2 to 5 cc. hypodermic syringe fitted with a small needle.

(10) Towels.

(11) A small amount of .5 per cent novocaine solution.

The glass articles must be meticulously cleansed of all macroscopic contamination and then sterilized by boiling in distilled water to which nothing at all has been added, the boiling also being performed in a scrupulously clean container. The gloves and towels are sterilized by autoclaving in the usual manner. Pure gum rubber tubing should be used in constructing the apparatus and should be soaked as an added precaution for six hours in normal hydroxide solution prior to preparing it for its first sterilization.[26]

The blood transfusion itself proceeds in the following manner:

(a) One arm (conveniently the left) of both donor and recipient is prepared by skin sterilization and sterile draping as for a minor operation on the antecubital fossa.

(b) A rubber tourniquet is applied to the arm of the donor above the elbow with sufficient traction to occlude the venous return from the arm without interfering with the arterial supply, and the most prominent vein at the bend of the elbow is identified. The cuff of a blood pressure apparatus may be used as a tourniquet.

(c) In the skin over a convenient point in the course of the vein a wheal is raised with 0.5 per cent novocaine solution using the hypodermic syringe and needle.

(d) The 100 c.c. cylinder is now filled to the mark with the sodium citrate solution; 10 c.c. of the latter solution is poured into the bottom of the 500 c.c. graduate. The citrate solution is swirled about the sides of the graduate so as to leave a thin film of solution over the entire interior of the latter, and both graduate and cylinder are placed conveniently near the site of operation.

(e) The 10 to 14 gauge needle is now pushed through the wheal in the skin into the lumen of the vein, the 500 c.c. graduate being immediately placed under the open end of the needle to catch the issuing blood.

(f) The blood is stirred into the citrate solution with the stirring rod slowly and carefully, in order to avoid damage to the blood cells, yet not so deliberately as to run the danger of allowing clots to form.

(g) As soon as 100 c.c. of the mixture have been collected, 10 c.c. more of citrate solution are added from the graduated cylinder, and the stirring is resumed. This is repeated, 10 c.c. of citrate being added for each 90 c.c. of blood with constant stirring, until the required amount for the transfusion is obtained.

FIG. 23. Method of withdrawal of blood from donor when using "citrate method." Hand holding the needle is gloved and sterile; graduate and stirring rods are sterile but are being manipulated by unsterile hands, since all that is necessary is to protect the inside of the graduate and its contained fluid from contamination. Citrate solution is added in 10 c.c. amounts previous to the reception of each 50 c.c. of blood. Stirring with glass rod is performed deliberately to avoid foaming but sufficiently rapidly to insure continuous and thorough mixing of solution. If any considerable time must elapse between reception and reinjection of the blood, chilling of contents of graduate must be prevented by immersing graduate in warm water.

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(h) The tourniquet is now released, the needle withdrawn, and pressure is applied with a piece of cotton or gauze over the site of puncture for about thirty seconds.

Provided that the operator is at all skilful in venipuncture this technique should suffice in all but unusually difficult cases, and all of it can be performed when necessary by a single pair of hands if a little care and foresight be used in planning the various maneuvers. The direction in which the needle is made to point, whether toward or away from the hand of the donor, is of little moment, provided that the vein being punctured is of reasonable size. In cases in which small veins are the only ones available the direction pointing toward the hand is advisable, lest the caliber of the needle be so great as to occlude the lumen of the vessel and embarrass the circulation going to the tip of the needle; in rare cases and in obese persons it may be necessary to perform a formal venesection with cannula introduction, such as will be described presently in connection with the recipient.

The attention of the operator is now directed to the recipient. A judgment must first be made as to whether it will probably be possible to introduce an 18 gauge needle into the recipient's vein, or whether it will probably be necessary to cut down upon the vein, thus performing a formal venesection. In case an attempt at the former is deemed advisable, the citrated blood is now poured carefully, so as to avoid bubbles, from the graduate in which it was received, into the salvarsan apparatus, holding the needle adapter, attached to the latter, at a level sufficiently high to prevent loss of blood through it. The blood must be strained through several layers of gauze placed over the top of the salvarsan apparatus, if any doubt exists in the mind of the operator concerning the freedom of the blood from clots. The salvarsan reservoir may now be hung upon a suitable stand or may be given to an assistant to hold, the rubber tube having previously been completely filled with blood and the tube near the needle adapted being either collapsed by a suitable clamp, a pair of
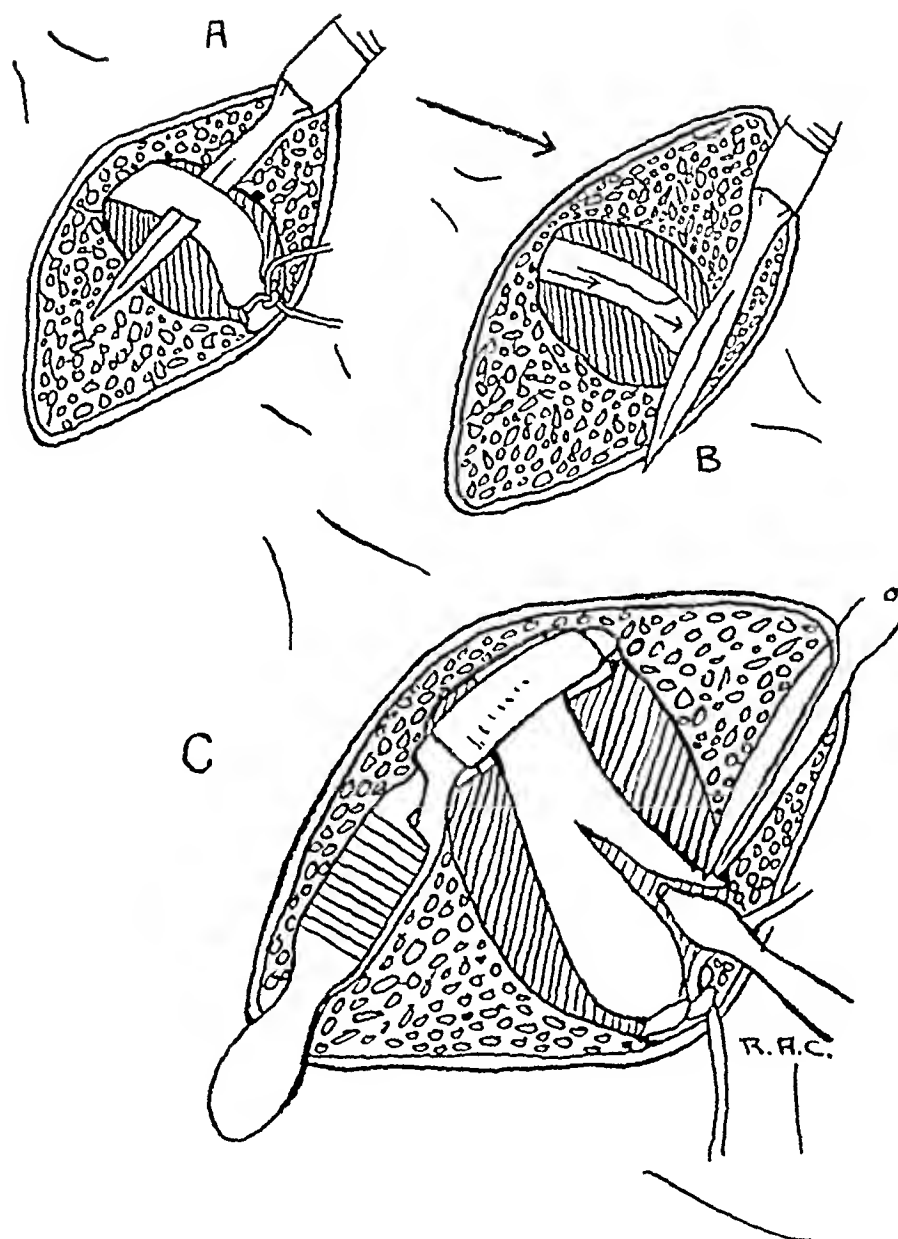
Fig. 24. A very satisfactory method of preparing a vein for insertion of cannula. At A the vein has been isolated and dissected free of all extraneous tissue; a very sharp Graefe knife has been thrust through the vein, pulled toward the operator, and has been turned outward in the process so as to cut a long flap in the wall of the vein. At C point of flap has been caught in mosquito forceps and is being elevated to admit point of a cannula; in this insert the vein is shown tied proximally and clamped with rubber covered bull dog clamp distally; bull dog clamp was omitted from succeeding drawings merely in order to secure more detail; for obvious reasons, it should, however, be applied before the incision into the vein is begun.

[623]

hemostats, or more simply, by folding the tube upon itself and squeezing the folded portion. The 18 gauge needle is now taken, and, after applying the tourniquet to the arm of the recipient
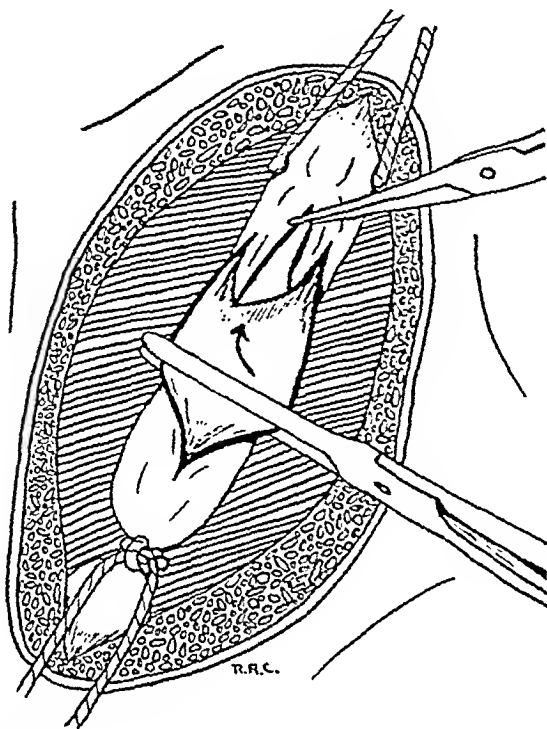
Fig. 25. Modification of technique especially suitable for use when veins are small and difficult to cannularize. Vein has been opened according to technique shown in previous figure; vein has been tied proximally, but instead of using a rubber covered clamp distally the lumen of the vein is obliterated merely by traction on a ligature. A smooth long-bladed forceps has been clamped across open part of vein to flatten it. Cannula is introduced in direction shown by arrow.

in the same manner in which it was applied to the arm of the donor, a suitable vein is selected in the antecubital fossa and the needle is thrust into the vein in the direction of the flow of blood. As soon as it is assured that the needle point is within the lumen of the vein and blood is seen to trickle freely from the end of the needle, the adapter of the salvarsan apparatus is rapidly attached to the end of the needle with as little loss of blood as possible and without the formation of air bubbles, and the citrated blood is allowed to flow by gravity into the

veins of the recipient. As soon as the proper connection has been made the tourniquet is, of course, quickly removed from the arm of the recipient. The lumen of the 18 gauge needle is
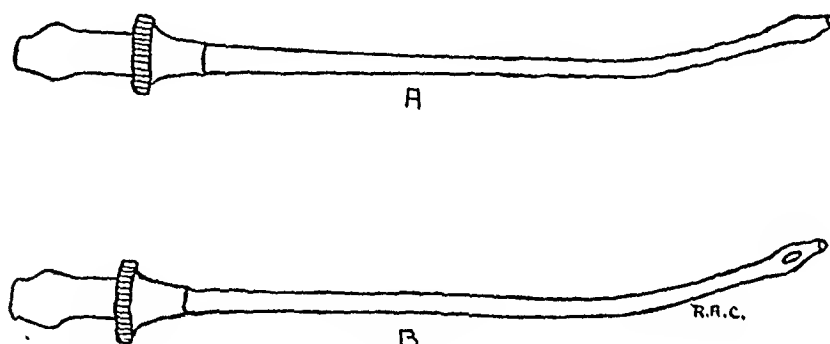
FIG. 26. Two common types of venous cannula. Cannulae are made of metal. A and B are similar except that B has an opening in side of expanded end as well as at tip.

relatively small, and a correspondingly long time is necessary for the giving of the transfusion. The observation window is watched during the first few minutes to guard against the possible entrance of air bubbles into the vein, and mental notes are made subsequently at frequent intervals of the level of the blood in the graduated part of the salvarsan instrument, so that the rate of flow may be calculated and any possible blockage of the needle by clots may be readily appreciated. Toward the end of the transfusion the observation window in the apparatus is watched for the appearance of the last remnants of the blood, and when the meniscus is seen to descend to the level of the window, the apparatus is quickly detached from the patient by withdrawing the needle, and firm gauze pressure is exerted over the vein for several minutes.

Not infrequently in the debilitated or the exsanguinated patient the introduction of a needle into the vein of the recipient is a procedure either difficult or impossible of accomplishment. In these cases formal venesection becomes necessary, and this procedure is performed as shown in the illustration reproduced here. An incision is made with a scalpel by picking up the fold of the skin in the antecubital fossa between the thumb and the forefinger of the left hand and sticking the

scalpel point first through the fold, the blade being directed outward, and the incision being completed by carrying the scalpel outward through the remaining tissue. This avoids possible injury of veins just below the surface of the skin invisible because of collapse.

A suitable vein is now identified and dissected free by blunt dissection. An aneurysm needle armed with a suitable ligature is now passed below the vein, the loop portion being grasped and the aneurysm needle being withdrawn, thus leaving a double ligature below the vein. The loop of this ligature is then cut and one of the pieces thus formed is tied tightly about the vein at its distal portion. The other portion of the ligature is tied loosely about the proximal portion of the isolated vein with a single knot in anticipation of subsequently tightening the latter about the cannula, a mosquito forceps is securely fastened to a small piece of the wall of the vein, the mosquito forceps being held in the left hand and slight traction being applied to it so as to render the vein distal to the forceps taut. The points of a pair of scissors are then made to slit the wall of the vein just below the points of the mosquito forceps, and into the gap or slit thus made the cannula is promptly introduced. During this latter procedure care should be taken that the intima is not rolled up within the vein thus occluding the lumen of the cannula. When the position of the cannula and the patency of its lumen are assured, the mosquito forceps may be removed from the wall of the vein and the ligature previously placed about the proximal part of the vein may be tightened about the cannula. Blood should now trickle from the end of cannula, the salvarsan apparatus containing the citrated blood should be immediately attached to it, and the institution of the process of transfusion should be begun.

The transfusion proceeds in the manner previously described, and is terminated by loosening the ligature about the cannula, withdrawing the latter and tying the ligature firmly about the vein, without allowing air embolism to occur. The

skin wound is closed with a couple of sutures, and the transfusion is thus completed.

VIII. The Indications for Blood Transfusion

Regardless of the method used, three general functions are definitely fulfilled by transfusion, all of which are somewhat interdependent:

1. Transfusion adds fluid bulk to the blood stream, and accordingly shows a rapid pulse and raises the blood pressure of the patient suffering from the shock of hemorrhage.

2. Transfusion increases the number of circulating red blood cells, thus increasing the oxygen-carrying capacity of the blood, improving the color of an anemic patient, and relieving him of his air hunger.

3. Transfusion stimulates hematopoiesis. This results probably not, as formerly thought, by direct stimulation of the bone marrow as the result of the action of broken down and hemolyzed donor's red corpuscles, but rather by improving the general nutritional condition of the patient and thus interrupting a vicious circle, viz., decreased oxygen-carrying capacity, leading to decreased nutrition of bone marrow, leading, in turn, to decreased red blood corpuscle formation and to anoxemia.

In case the coagulation time of the recipient is abnormally prolonged transfusion tends to decrease it.

There are no absolute contraindications to blood transfusion save pulmonary edema; but one should proceed with care and only after considerable deliberation in cases in which there is grave damage to the myocardium and in cases of advanced nephritis.

In a specific way transfusion has been suggested as a valuable method of treatment in six groups of cases:

1. In actual hemorrhage
   A. Due to accidental trauma
      1. Street and industrial accidents
      2. Stab and gunshot wounds of civil and military life
   B. Connected with certain vascular disasters secondary to local disease
      1. Peptic ulcer (especially gastric)

       2. Post partum hemorrhage

       3. Ruptured ectopic gestation

       4. Typhoid hemorrhage

       5. Ruptured esophageal varices

       6. Massive hemoptysis in pulmonary tuberculosis

   c. Secondary to surgical operation

       1. To reestablish the normal blood bulk
         —depleted by bleeding at the time of operation
         —depleted by postoperative hemorrhage

       2. To combat postoperative shock (bleeding of the patient into his own blood vessels)

II. In certain purpuric conditions

   A. Purpura hemorrhagica

   B. Hemophilia

   c. Icterus

III. In certain blood dyscrasias

   A. Pernicious anemia

   B. The leukemias

IV. In certain infections

   A. Ordinary infections with pyogenic organisms

   B. Endocarditis lenta

V. In certain intoxications of a non-bacterial nature

   A. Eclampsia and the toxemia of pregnancy

   B. Uremia

   c. Illuminating gas poisoning

   D. Benzol poisoning

   E. Toxemia connected with extensive superficial burns

VI. In connection with general debility

   A. Anemia

   B. Cachexia of carcinoma

In general the groups are arranged in an order corresponding to the supposed value of transfusion in the various conditions enumerated, transfusion being of the most value in the first group and of less value in succeeding ones. In arranging the sub-groupings, however, no particular attempt has been made to correlate numerical order with efficacy, as such

an attempt could hardly be successful in the light of present knowledge.

A. Transfusion for Hemorrhage: Hemorrhage has always constituted and still continues to constitute the fundamental indication for transfusion. In cases of hemorrhage blood transfusion is specific. Provided that a patient is not completely moribund no degree of loss of blood is so great that the patient cannot be revived by immediate and adequate blood transfusion.

To know when transfusion has become necessary, and better still, to know when it has become advisable is sometimes a difficult matter. A truism which will bear repetition affirms that the time to transfuse a bleeding patient is the first moment one considers the advisability of doing so. Patients may die in spite of transfusions at the eleventh hour who would have rallied very promptly had the procedure been invoked just a little earlier. There are undoubtedly exceptions to the rule about to be given but it can be taken as pretty generally true that patients will not ordinarily survive depression of the systolic blood pressure to 80 mm. of mercury, or of the diastolic pressure to 40 mm. for longer than an hour. It is true that death may not immediately ensue; indeed, the blood pressure may subsequently be increased either by blood transfusion or otherwise, and the patient may rally temporarily, but the improvement is not permanent, and such patients characteristically die in a day or two, oftentimes evidencing no particular untoward symptoms at the end. It seems probable that in the average case sufficient cellular damage is done by such relative failure of the circulation as permanently to prevent the subsequent reestablishment of biochemical and physico-chemical equilibrium.

The prophylactic use of blood transfusion in deliberate surgery probably deserves much more attention than it has previously received. It has been amply demonstrated in connection both with animal experiments and in connection with "donors" for blood transfusions that the amount of

blood which can be lost by a healthy individual without developing untoward symptoms is somewhat greater than one quarter of the total quantity in the circulation. The normal adult human being, accordingly, can lose from 500 to 750 c.c. of blood with little or no inconvenience. It would appear that more than such amounts of blood are perhaps not infrequently lost during the course of certain operative procedures, especially those in which diffuse capillary oozing persists during a considerable part of the period occupied by prolonged operative procedures. Exact measurements of the blood loss accompanying operative procedures are woefully lacking, but Gatch and Little,[27] using a colorimetric method applied to blood recovered by washing the gauze sponges used during the course of operations, estimated that 304 c.c. of blood were lost during a hysterectomy operation for fibroids, 710 c.c. during the radical amputation of a breast, and 816 c.c. during the course of a nephrectomy. If amounts of blood such as these are commonly lost in connection with operative procedures, volumes which are in the vicinity of, if not actually greater than, the amount necessary to produce symptoms in healthy individuals, it is little wonder that patients already debilitated by disease who frequently show marked anemia as a part of their debility frequently develop symptoms dependent upon blood loss postoperatively.

A condition of anemia is particularly likely to be found in patients the victims of gynecological diseases in whom menorrhagie and metrorrhagia have been present for relatively long periods of time. Patients with carcinoma uteri and those with incomplete abortions and ruptured ectopic gestations are apt to be markedly anemic. Patients with carcinoma of the rectum or of the stomach or duodenum who have suffered repeated small hemorrhages or several massive ones belong in the same class, and even patients with simple hemorrhoids may have become very anemic as the result of the chronic oozing of blood from the rectum.

Transfusions in the hemorrhagic group of diseases have given only fairly good results. In hemophilia and the hemorrhage of the newborn, especially melena neonatorum, transfusion is almost a specific for the control of the hemorrhage. Transfusions do not, however, cure the condition of hemophilia, and frequently several small transfusions are required to control hemorrhage. In jaundice, even when due to a blockage of the common bile duct of long standing, transfusion will almost completely control oozing at the time of operation.

In the group of blood dyscrasias, transfusion is as good a form of treatment as is known in pernicious anemia, although the results at best are discouraging. Transfusion seems frequently to be of value in initiating a remission of symptoms, but there is no evidence that it is of any curative value at all, and many have questioned whether its employment is justified by the temporary improvement which it may produce. In lymphatic leukemia the best results are secured by exsanguination transfusion in which comparatively large doses of blood are given; the good effects are merely temporary.

In acute sepsis transfusion is useless, but the group of chronic infections are often benefited to a surprising degree by the administration of blood; this is particularly true in cases of recalcitrant residual abscesses, empyema, osteomyelitis, and the like.

In illuminating gas poisoning exsanguination transfusion constitutes the best treatment. This consists in withdrawing and discarding from 700 to 1000 c.c. of the patient's blood and transfusing a similar amount.

b. The Dangers of Blood Transfusion: The dangers of blood transfusion are:

1. Incompatibility.
2. Too large a transfusion.
3. Emboli, air, or blood clot.

In the blood dyscrasias transfusions of 250 to 350 c.c. seem to do about as much good as larger ones. In infants

under six months of age 60 to 90 c.c. suffice, injected into the external jugular vein or the longitudinal sinus.

In the infant before the closure of the anterior fontanelle, blood transfusion is readily accomplished by making use of the longitudinal sinus. The superior longitudinal sinus lies exactly in the midline at the anterior fontanelle but deviates to the right posteriorly. The needle should therefore be introduced just in front of the posterior angle of the anterior fontanelle and should be directed backward at an angle of $45°$ with the interparietal suture. The depth is scarcely more than 1_{16} in. The needle must be held steady by resting the hand against the child's head.

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